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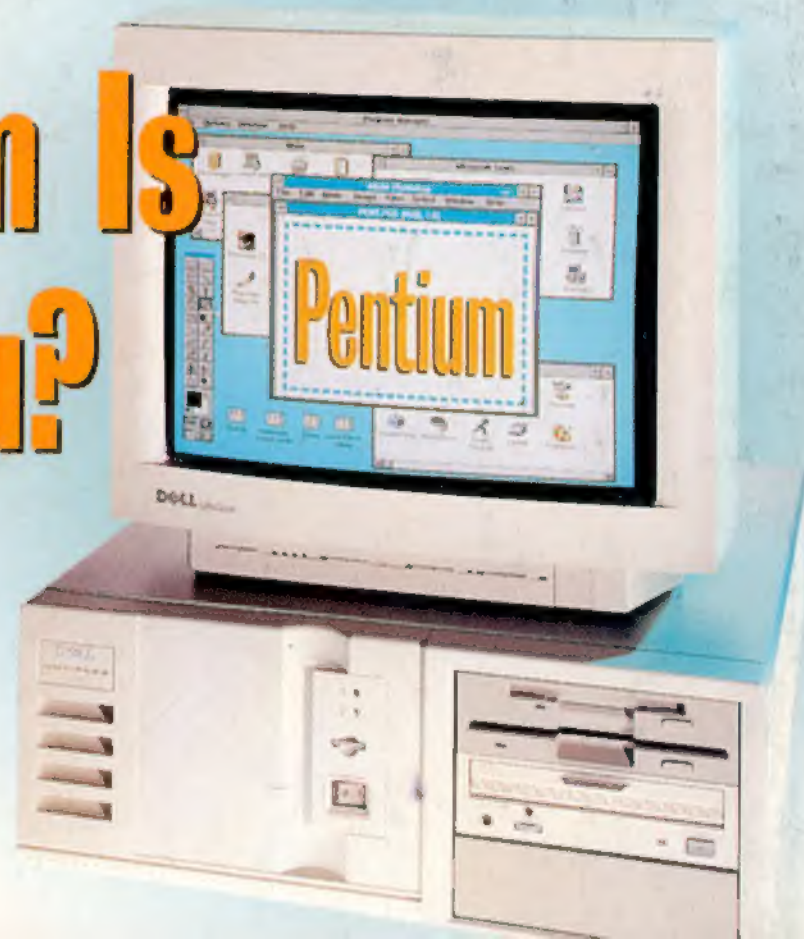
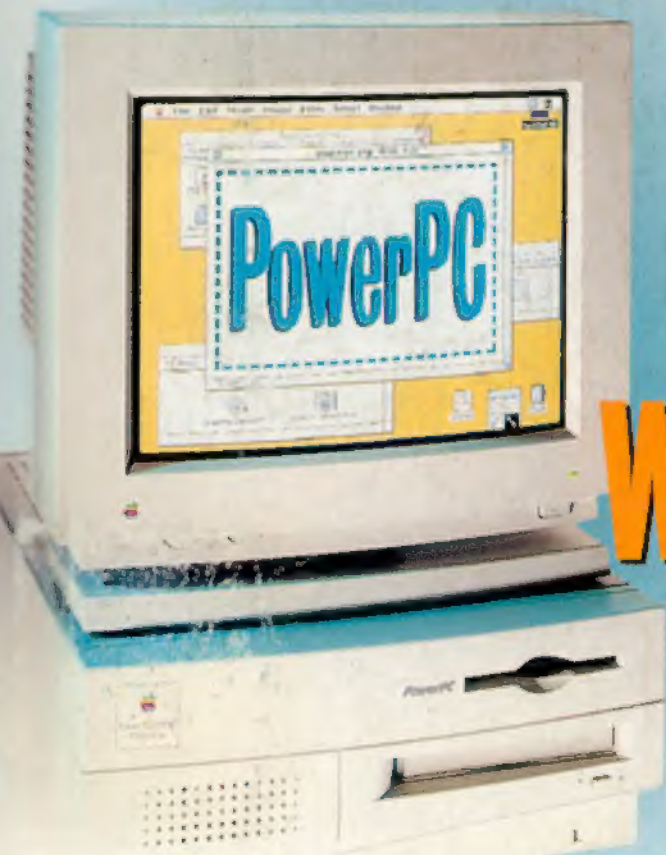
We Test: The First PowerPCs

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6 Powerful Application Servers

POWERPC VS PENTIUM

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Right for You?



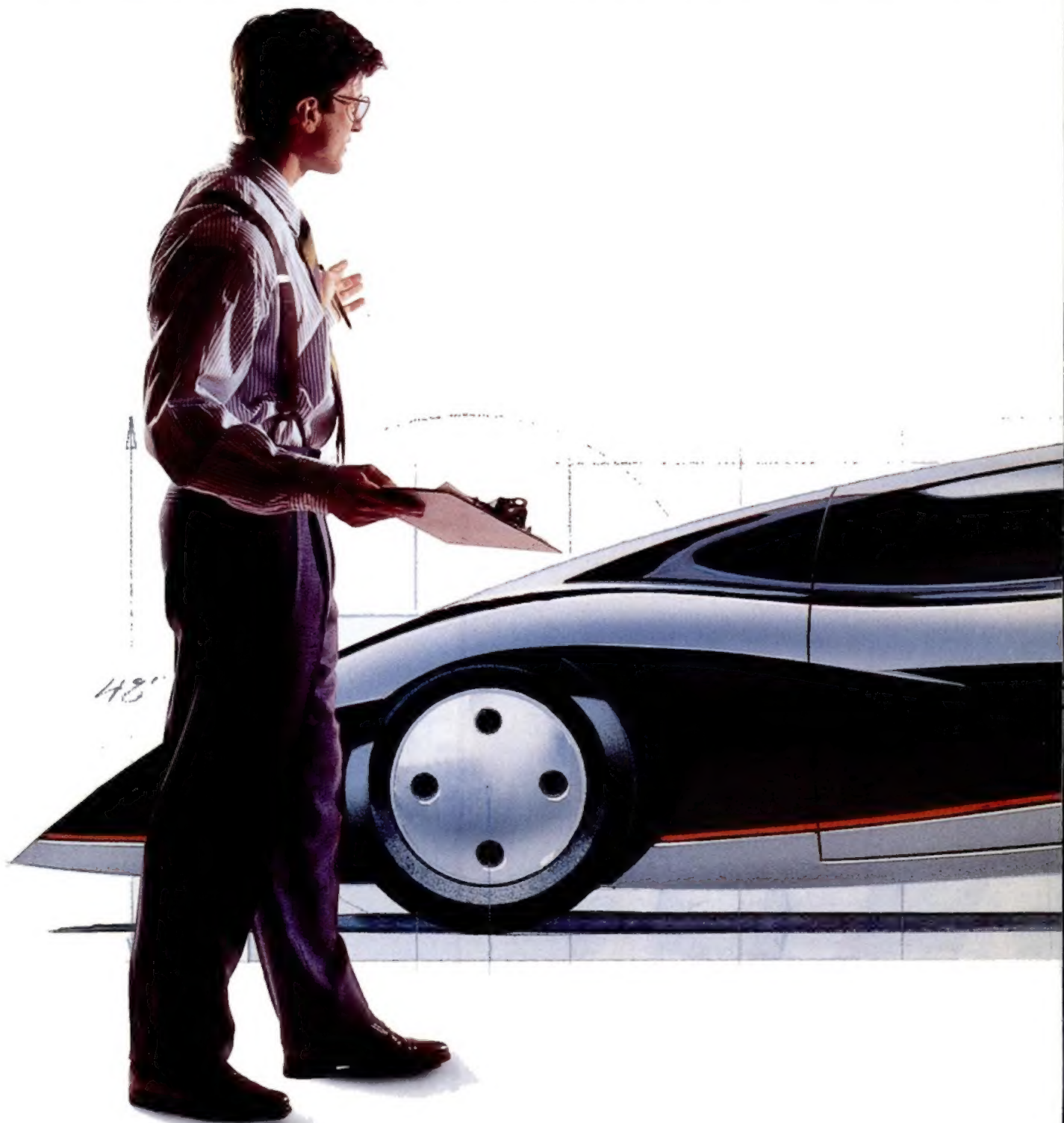
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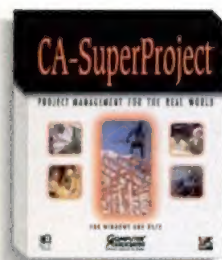
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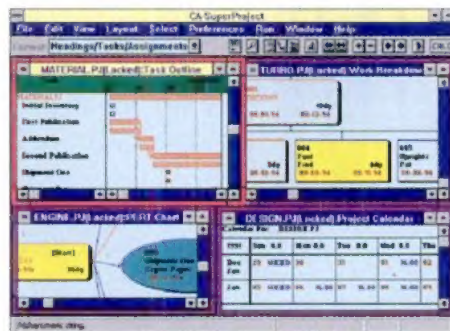
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Inside

Marshall McLuhan said, "The medium is the message." And as we look at new forms of electronic media, it seems he was right. For on-line services, interactivity is the key. This is nothing new for *PC Magazine*. For years we have had

our PC MagNet service and have been a part of ZiffNet on CompuServe. Now we are also part of ZiffNet on Prodigy. These services let us stay in closer contact with our readers, and it's not unusual to find heated discussions of our reviews or reactions to the opinions of our columnists posted on-line.

We've also recently completed the second version of PC Magazine CD, designed as a companion to the

**PC Mag
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printed magazine. (To order a copy, call 800-787-9677.)

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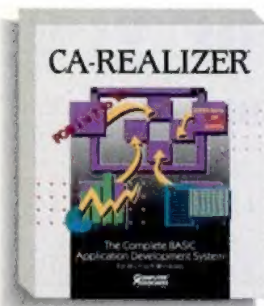
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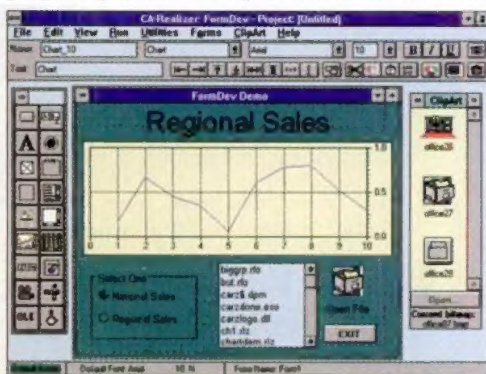


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BY MICHAEL J. MILLER

Is it finally time for a RISC-based PC to take its place on your desktop? Or will Intel Corp.'s Pentium and its successors continue to rule as king of the hill? *PC Magazine* takes a hard look at the new generation of chips, operating systems, workstations, and servers to see which ones hold the most promise today and in the future.....112



Is it time for a desktop transaction?

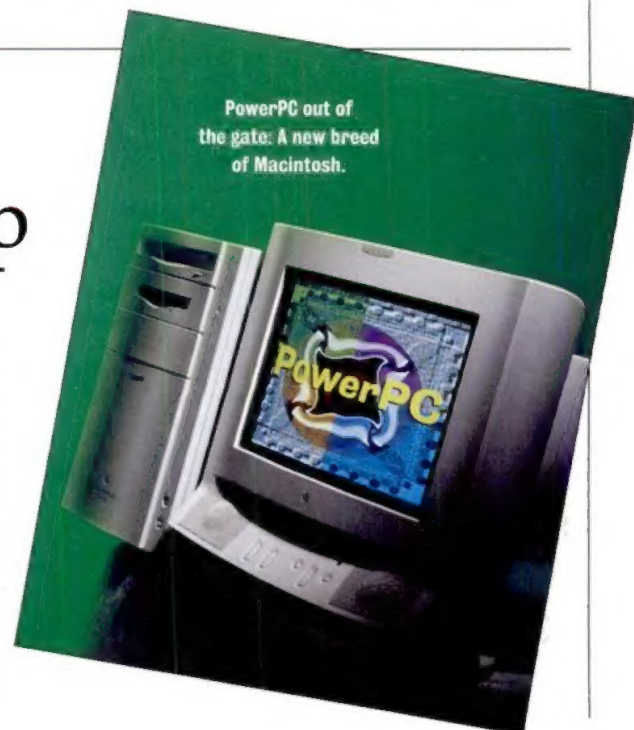
Pentium vs. PowerPC

Battle for the Desktop

BY JOHN CLYMAN

The long-awaited PowerPC architecture has arrived in the form of new Apple Macintosh systems and a new IBM workstation. Was it worth the wait? How does it stack up against the Pentium? *PC Magazine* analyzes the first PowerPC machines to hit the market to see if they just might be right for you.....114

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Ready for the Desktop?

BY JIM SEYMOUR

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One Size Does Not Fit All

BY NICK STAM AND TAMI D. PETERSON

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Different servers suit different needs.



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BY DAVID S. LINTHICUM

DOS has seen its day, and the hourglass is running out for 16-bit Windows. As the 32-bit era finally dawns, it's time to pick a multitasking, multithreaded, graphical operating system to power your Intel system in the future. To help you make the choice, we

match IBM's OS/2 2.1 and Microsoft Windows NT against industrial-strength Unix systems from NeXT, Novell, SCO, and SunSoft. Here are their strong points and shortcomings in multitasking performance, network connectivity, DOS/Windows emulation, hardware support, application availability, and development tools203

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Dial-Up Routers: Speaking LAN to LAN

BY GARY GUNNERSON

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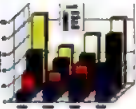
Thompson & Associates

December 30, 1990

Keith Koyen
Thompson & Associates
1135 Washington Street
Atlanta City, GA 30309

Dear Mr. Koyen,

It was a pleasure meeting you at our reader visit of 11 December 1990. The following is a quick overview of the issues discussed and our preliminary findings.



As you can see by our annual evaluation, the overall financial performance of your organization continues to be strong. The factors you have positioned yourself with for continued growth in the marketplace. However, we will review the information you have provided and make a more in-depth analysis regarding the factors you have positioned yourself with for continued growth in the marketplace. We will review the information you have provided and make a more in-depth analysis regarding the factors you have positioned yourself with for continued growth in the marketplace.

You can expect to see our detailed report on 15 January 1991. We will work to provide you with key metrics to monitor your success and target the future developments.

Have a very happy holiday season! I look forward to seeing you in the New Year!

Sincerely,

Mike Thompson
Principal

414 222-1100 / 414 222-1101 / 414 222-1102 / 414 222-1103 / 414 222-1104

Mike, Eaton Town, NJ

Kusak Enterprises, Inc.

1780 Capital Way, Seattle, WA 98101

Paul Kusak
President
Owner & Chairman
1780 Capital Way
Seattle, WA 98101

December 18, 1990

Dear Paul,

Thank you for allowing our report author to visit your area. I have enclosed the following information in this document.

- A transcript of the meeting and presentation
- A brochure detailing our background and publications

Enclosed you will find the information and have any one who could not attend call Paul Kusak at 206-461-1100. In many cases the Tele-voice Automated Service System (TASS) appears best for most.

Task	Done	Not Done
Task 1	✓	
Task 2		✓
Task 3	✓	
Task 4		✓
Task 5	✓	
Task 6		✓

Building with agreed support for this type of system is essential before pursuing procurement or funding. It is important to agree on the system and the A/SB in the early stages of your evaluation to ensure the application will be successful. I would be glad to present another brief demonstration of our system for you, demonstration, training, ITA, parents and any other business interested in sponsoring an A/SB.

Thank you again for your interest and participation in our system. If you have any questions or comments please feel free to contact me at 206-461-1100. I look forward to working together to bring this truly worthwhile service to the community.

Sincerely,

Paul

Lisa, New York, NY

All we ga was 30 minutes. first docume

Memo

To: Mike Tyson
From: Sharon
Date: December 18, 1990
Regarding: I'm going on vacation!

After working my fingers to the bone, I'm proud to announce that I'm taking a long vacation. I'll be spending five relaxing days at the Blue Bird Beach Resort in San Diego.

• December 24 - 28

I've arranged for the following people to cover my absence:

Accounting	Company Vice President
Administrative Services	Business Development
Administrative Services	Client Services
Administrative Services	Customer Service
Administrative Services	Human Resources
Administrative Services	Marketing
Administrative Services	Operations
Administrative Services	Production
Administrative Services	Quality Control
Administrative Services	Research & Development
Administrative Services	Sales
Administrative Services	Training
Administrative Services	Warehouse

Thank!

See you all soon.
Sharon...

Sharon, Poway, CA

ECONEWS

Organization Summary

Since 1980, the organization has been a leader in the field of environmental protection. The organization has been a leader in the field of environmental protection. The organization has been a leader in the field of environmental protection.

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Management Summary

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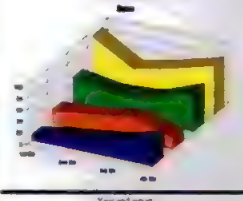
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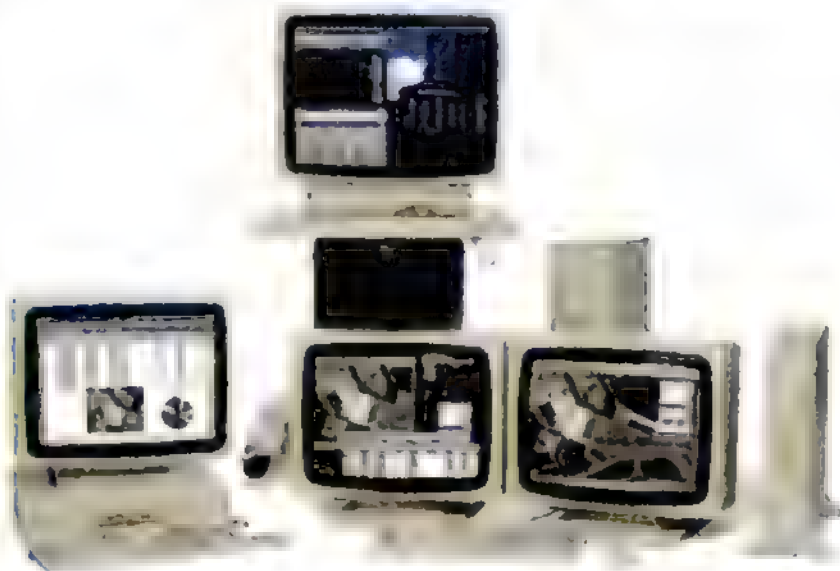


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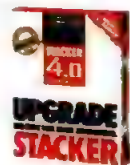
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CIRCLE 061 ON READER SERVICE CARD

Letters

PATENTS NOT PENDING

The granting of software patents does far more harm than good, but I disagree with Michael J. Miller's assertion that copyright protection is an appropriate system for protecting software authors ("Software Patents Must Go," March 15, 1994).

While there can be artistry and elegance in writing program code, software is clearly different from the literary, musical, and dramatic works to which copyright protection has traditionally been afforded. Program code is more akin to an invention, a process, or an idea. It has not helped matters that both the Canadian and U. S. legislatures have been too quick to extend the old copyright regime to include software/firmware.

In order to rid the marketplace of wasteful litigation, foster ingenuity, and allow true free-market competition while still protecting the rights of software authors, a new intellectual property regime for software, if not computers in general, is required.

*Richard Goldman
via PC MagNet*

So Miller believes Congress should make "more explicit laws detailing what software copyrights can and should cover." I agree with Miller's diagnosis of the problem. Lawsuits are stifling innovation and making software more expensive for users. However, Miller's cure—new legislation—may be worse than the disease.

Congress is largely composed of lawyers. If the legislature starts reforming intellectual property law, it'll broker a compromise that nobody likes, one that has every chance of being worse than the present law.

*Alan Lawhon
Hunstville, Alabama*

There's no question that Congress, not the judiciary, is the proper branch of government to make such a change. However, Miller's contention that small software producers are defenseless against claims of patent infringement by big players is not always the case, as shown in the recent victory of tiny Stac Electronics over giant



*A new intellectual-
property regime for
software is required.*

Microsoft. In the hands of counsel knowledgeable about software patents, David can defeat Goliath.

While a congressional change of the patent laws may prevent future bad software patents from being issued, the best way that a threatened party can thwart the enforcement of improper software patents already issued is to challenge such patents' validity at every opportunity.

*Anthony Claiborne
via the Internet*

It seems to me that, contrary to Miller's column, copyright law alone was not able to provide the type of "big stick" protection needed in the case of Stac Electronics versus Microsoft, which resulted in a huge victory for Stac. As the scope of copyright protection for software continues to shrink thanks to software's basic problem of function-driven expression, the development incentive needed for software patents will undoubtedly increase. The notion that the evolutionary nature of software reduces the quantity of inventive software development ignores the reality that all inventions are and always have been merely combinations of old elements.

*Jeffrey R. Kuester
Atlanta, Georgia*

Miller's resorting to clichés in typifying lawyers as bogeymen detracts from his point. Lawyers don't file lawsuits. Lawyers represent persons or companies who choose to file lawsuits to protect their rights. Some people use the system of patents to extract economic blackmail or quash competition, but these are the actions of business executives seeking to gain an advantage.

*Randolph P. Stainer
Tulsa, Oklahoma*

DIGITAL PHOTOGRAPHY COMES OF AGE

"A Photographic Memory for the Digital Age" (February 22, 1994) was a well-researched, complete, and balanced article on the complex subject of Photo CD. The article touched on many of the major issues without falling into the gee-whiz new-technology trap. Especially appreciated was the coverage of Kodak's continuing lethargy in providing support for those professionals using imaging technology on the Microsoft Windows platform. Hopefully this airing of the issue will increase public outcry and result in Kodak placing a higher priority on Windows support, considering that Windows is a rapidly expanding segment of the professional imaging market.

*Wayne A. Munn
via PC MagNet*

SPRING CLEANING AT SERVICE BUREAUS

I found a lot to agree with in Jim Seymour's column "The Service Bureau Scandal" (February 22, 1994). As typesetting supervisor of a small service bureau, I see plenty of file-printing problems daily. However, unlike the bureaus described by Seymour, our entire operation is PC-based. Our experience shows that if customers correctly configure their printer drivers to download fonts (PostScript or TrueType), then nearly all font problems will be solved. To facilitate service further, users should know their bureau's image setter and load that printer driver into Windows; they should also always be sure to make a print file as well.

*Randall C. Bodine
Ijanesville, Maryland*

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LETTERS

Yes, many service bureaus are steeped in Macintosh history, but some of us aren't. Our bureau has several Macs and several PCs tied together with NetWare running to four different image setters. And yes, I agree: If you're going to use the PC for desktop publishing, find a bureau that will print your file from its native PC application using your fonts.

No service bureau, whether Mac or PC-based, is going to know all the tricks in all the programs to make every file work. It's a mathematical impossibility.

Steve Godwin
Tucson, Arizona

As a PC publisher who has been confronting and been confronted with service bureaus for about five years now, I greatly appreciated Seymour's column. I once had a service bureau manager actually tell me to go out and buy a Mac. The reasons I gave for not doing so were summarized nicely in Seymour's column.

Wayne Kaplan
via PC MagNet

SHRINK-WRAP LAW OF SELECTION

In her column "Binding Agreements" (Pipeline, February 22, 1994), Robin Raskin expresses concern about shrink-wrap licenses that are placing limitations on software's use in reviews. I agree that this practice is a cause for concern, since it is an attempt by software companies to control what is said about their products. But I am less worried over how much impact such limitation clauses will have.

Software developers are acutely aware that customer satisfaction is key to their profitability, and magazines such as yours are a primary way that developers disseminate positive information about their products. If it is disclosed that a vendor has refused to let you review its product, there will be a backlash from readers—the consumers who really count.

Phil Severson
Glastonbury, Connecticut

Raskin asks whether vendors should be able to place restrictions on how or whether their products should be re-

viewed by the likes of *PC Magazine*. I feel that it should be an in-or-out proposition: Either the vendor permits its product to be reviewed—no strings attached—or else the product is not mentioned anywhere.

George Allen
via the Internet

Raskin's Pipeline column hit on one of my pet peeves. Shrink-wrap agreements have no legally binding force whatsoever, because they're unilateral attempts to change the terms of a contract retroactively.

Alan Wachtel
Palo Alto, California

TRANSLATING A TOWER OF BABBLE

John C. Dvorak's musings on computer translations of language are optimistic (Inside Track, February 22, 1994). To translate specific technical documents, computerized translations can actually be quite useful, because enough memory can be assigned to the specific idiomatic forms. But to translate poetry and prose

from one language to another by computer appears to be impossible at this stage. Adequate electronic language translation is still very far removed from reality, and for now, an educated native speaker would seem a much wiser investment.

Paul A. van den Bergh
Fountain Hills, Arizona

RECONSIDERING CARPE DIEM

Bill Howard's column "Buy Now, Buy Smart" (February 22, 1994) failed to mention perhaps the most compelling reason not to buy now: bus architecture. There is little question that a 32-bit bus is on the horizon, but what implementation will dominate—VESA, PCI, EISA, MCA? Although there is no clear indication of which bus architecture is going to dominate, right now is the time to start researching bus options so that an intelligent choice can be made 8 to 12 months down the line.

Mark Jensen
via the Internet

CORRECTIONS AND AMPLIFICATIONS

The First Looks evaluation of Hewlett-Packard's HP Vectra VL2 4/100 (April 12, 1994) included an incorrect Winstone test result. With 8MB of RAM installed, the system scored 60.7, and with 16MB of RAM, it scored 80.0, putting it on a par with the other DX4-based systems we've tested.

The Gateway 2000 P5-60 configuration we tested and reviewed in "Unleashing the Power of Pentium" (April 12, 1994) sells for \$3,375, not \$2,795. Also, the pricing cited in our review of the AMS InfoGold PCI system is for a 14-inch monitor, not a 17-inch monitor, as stated.

Because our prepress service bureau's font was corrupted, many of the code listings throughout the PC Tech sections of our April 12 and April 26, 1994, issues had some substituted characters. The affected characters are as follows:

- A slashed D (Đ) should be a hyphen (-).
- An O with a tilde (Õ) should be a sin-

gle quotation mark (').

- An O with an acute accent (Ó) should be a double quotation mark (").
- An O with a circumflex (Ô) should be a single quotation mark (').

All corresponding files on ZiffNet are correct.

The correct address for Finansa, makers of WinMail, Version 1.5c ("The E-Mail Personae," April 12, 1994), is Finansa Ltd., The Garden Floor, Aldwych House, 71-91 Aldwych, London WC2B 4HN, England.

HOW TO WRITE TO PC MAGAZINE

We welcome your comments and suggestions. Please send correspondence to Letters, *PC Magazine*, One Park Ave., New York, NY 10016-5802. You can send electronic mail to our Internet address 157.9301@mcimail.com, or you can upload it to PC MagNet (see page 12 for access information). You can also send e-mail to individual editors. Type GO PCMSTAFF on ZiffNet for a list of addresses. All letters become the property of *PC Magazine* and are subject to editing.



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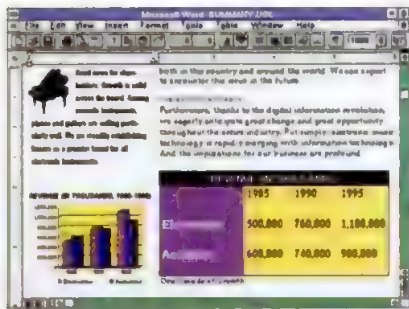
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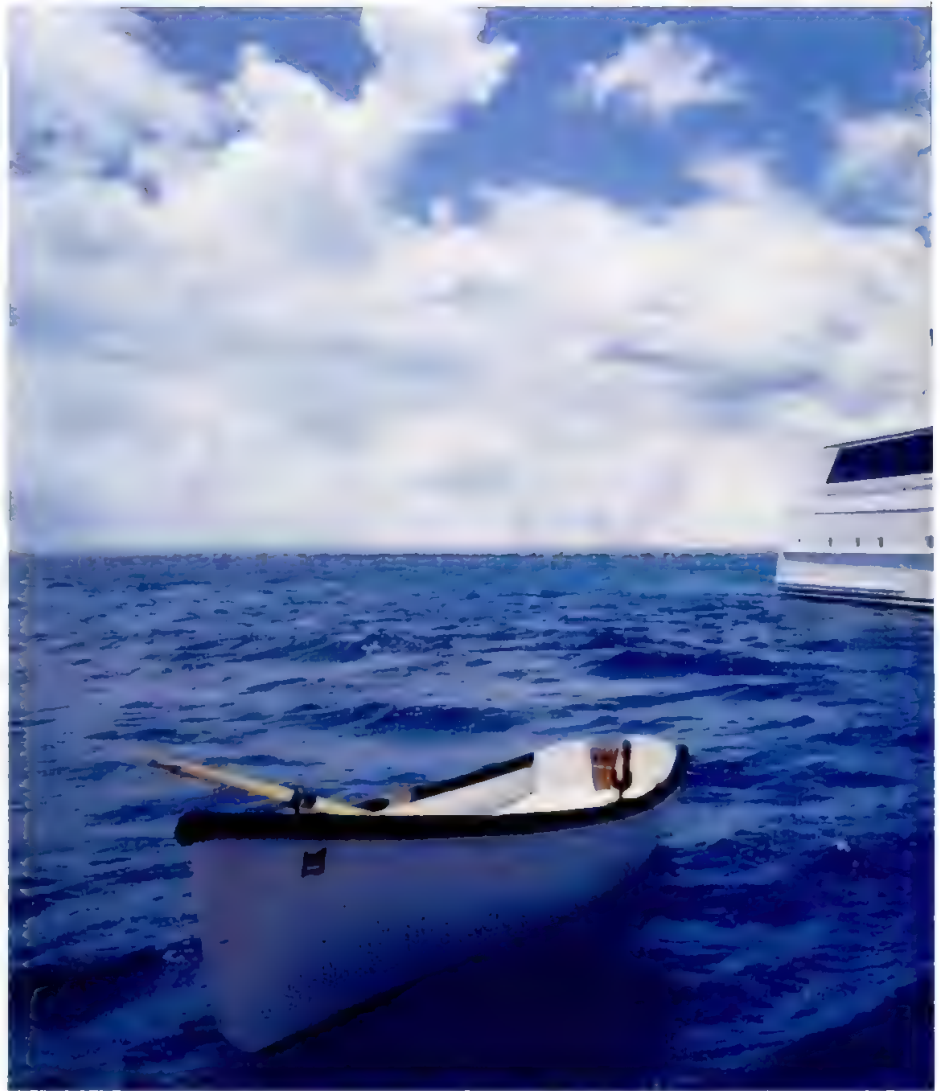
As well as the most acclaimed, *InfoWorld* recently stated, "We've found Microsoft Word 6.0 for Windows to be the best all-around



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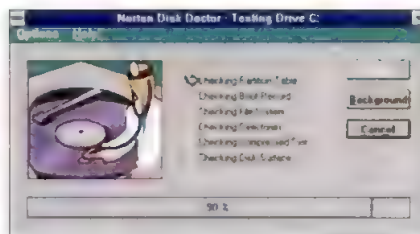
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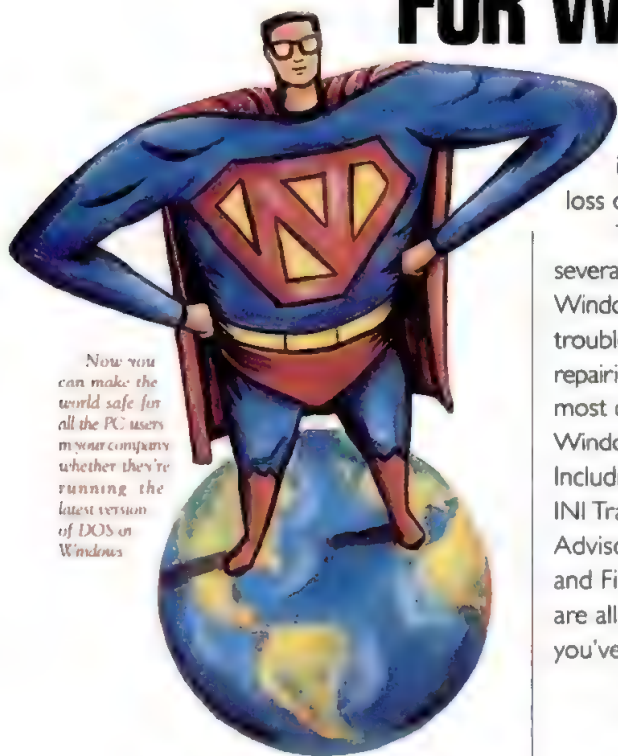


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Trends

TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

Big Deals

What will merger mania mean to you?



including electronic messaging, information sharing, document management, group scheduling, and conferencing that all share a common set of networking services. Novell also plans to integrate its Appware Visual App-Builder in future software.

Talk about software bundling!

The flurry of recent software mergers

is signaling a fundamental industry restructuring in the face of declining prices and shrinking profits. By pooling technology, research and development, marketing

resources, and clout to gain competitive advantages (and to keep up with Microsoft), software developers are hoping to shape a new class of applications.

Newlyweds Novell and WordPerfect predict their pending billion-dollar marriage will hasten a tectonic shift from the era of stand-alone software to the era of groupware. Ray Noorda, chairman of the board at Novell, says "We're in a critical period of consolidation as an industry. While the network infrastructure has been built, people have not fundamentally changed the way they use applications."

First, these Utah neighbors will begin work on converging messaging architectures—the WordPerfect Office messaging system and Novell MHS—into the Open Messaging Environment (OME) protocol. This will give corporate developers a work-group development environment for building custom apps, and will position Novell as a competitor to Lotus—whose Notes is taking off—and to Microsoft's upcoming groupware products, code-named Touchdown.

For consumers, Novell will launch Novell GroupWare, a family of software products

While Novell has positioned itself as an instant provider of a suite that includes WordPerfect, Borland's Quattro Pro (Novell also bought Borland's spreadsheet business), and Paradox, the company's long-term strategy views suites as an interim step toward tightly integrated and networked software components that work across Windows, Unix, and Mac environments.

Things are hopping on the west coast, too, where more alliances are poised to capture the graphics and game markets. Adobe Systems and Aldus plan to combine their expertise in electronic type, desktop publishing, and illustration in order to breed a new class of applications for the emerging electronic publishing industry. And earlier this year, game developer Electronic Arts acquired education software maker Broderbund Software in a bid to build a diversified interactive consumer media company.—*Carol Levin*

The Death and Life of PDAs

NEARLY A YEAR AFTER THE HYPE surrounding the launch of the Apple Newton, the state of hand-held computers can be best described as pathetic. Sales of Newtons and Tandy Zoomers have been disappointing, the EO Personal Communicator and its PenPoint operating system are dead, and Compaq has delayed its Windows Companion until next year. The problems? PDAs cost at least twice as much as buyers want to pay, handwriting recognition is ineffective, and wireless communications are too bulky and expensive.



a number of companies are moving full speed ahead. Most of the PDAs you'll see this year and next will be based on one of four major technologies: Newton, General Magic's Magic Cap, Microsoft's WinPad, and Geoworks. The devices that use Newton and Geoworks cores will be second-generation versions from Apple and AST.

Hewlett-Packard, which recently took an equity stake in Geoworks, plans to develop PDAs that will cost less than \$300. Apple and Sharp have already shipped Newton PDAs, and Toshiba recently licensed the Newton technology. While Apple may have the early momentum, designs of personal communicators

using General Magic's Magic Cap and mobile companions using WinPad are picking up steam. The first product to use the Magic Cap operating system is Motorola's Envoy. Fujitsu, Sony, and Toshiba have bought into the alliance but have yet to announce products. Microsoft's WinPad, which was first endorsed by Compaq, has recently picked up support from NEC, Olivetti, Sharp, and Toshiba. Microsoft says WinPad should be available near the end of the year.

IBM has been silent with its PDA plans. While it developed Simon, a cellular phone-based communicator that will be sold by BellSouth this summer, IBM has yet to disclose its operating system or product strategy. IBM is expected to rollout a family of PDAs toward the end of this year.

—*Christopher Barr*

Pipeline By Robin Raskin

Stop the Real World, I Want to Get Off

Life's little ironies grow more and more amusing each day. When I was a young mother, my hours on the computer offered me what little escape I had from my grueling, albeit fulfilling real life. Now, real life is haunting me whenever I sit down at my computer. I'm talking about "real-world interfaces"—one of the major trends in software development. The idea is to mask the complexity of software in metaphors with which users are comfortable and familiar.

This is not a new concept. In 1985, IBM (of all companies) introduced a product called TopView, where the metaphor was your desktop depicted as crudely drawn squares on the screen. We fondly referred to it as Slopview, and we cackled over the

idea that IBM could really believe we'd ever want our hard disks to look like our messy desks.

Years later, my hard disk has actually begun to look and feel like an iconic representation of my messy desk. Now I'm ready to face the next set of humiliations. In the past weeks I've been expected to stroll through little digital villages and

main streets, meet charismatic digital tour guides, and search for my files in different parts of a computer-generated house. I sure feel silly using all these real-life metaphors to get my work done.

Maybe it started when Microsoft Publisher 1.0 took to calling me Captain when I used its Wizard help or when Lotus first published 1-2-3 with Multimedia Help, which used circus animations

to provide excruciatingly cute explanations of things such as cut-and-paste.

Apple's e•world and General Magic's Magic Cap are constructed like little shops on Main Street. You visit the bank when you want to do a financial transaction; the newsstand when you want the news. The new Windows version of Managing Your Money also starts with a town scene but quickly transports you to a gender-neutral office where the desk drawers are gateways to your finances. Rand McNally has a new mapping program designed to help you plan vacations. It looks great, but you've got to endure yourself to a 1920s-style begoggledonaut who keeps popping up.

My checking program draws my checks for me, and my PIM looks like a filofax. Even my children are getting tired of Microsoft's McZee, the mascot of Creative Writer and Fine Artist who keeps popping up to fill the screen with how-to text. Just how many "real worlds" can a person stomach in one day?

Occasionally, there's an interface that's so seamlessly intertwined with the program that it's beautiful. Take a look at Broderbund's Myst for the ultimate example. All too often, though, the real-world interface requires too big a stretch of the imagination.

I expect that real-world interfaces are here to stay for a while. Their rich inconsistencies make me long for the days of a uniform C:\.

Robin Raskin is editor of PC Magazine.

Can NexGen Challenge Intel?

THE FIRST OF THREE PENTIUM challengers is about to don its armor and mount up. NexGen, a company that talked for many years about making its own 486 chip, has shipped samples of its Nx586 processor. Although not a clone, NexGen claims the chip is binary-compatible with Intel's Pentium processor, meaning it can run DOS and Windows applications directly. While it has many hurdles to jump before it gains mass acceptance, a few small computer companies do plan to ship systems based on the new chip.

The first goal is to get the chip manufactured. Samples distributed by NexGen were fabricated by IBM Microelectronics, but as of April, NexGen didn't have a firm manufacturing agreement. The other two Pentium challengers, AMD's K series and Cyrix's M1 processor, are not expected to have the same problem.

Like the Pentium, the Nx586 has a super-

scalar design, which means that it processes more than one instruction per clock cycle. Unlike the Pentium, the Nx586 uses an external floating-point unit similar to that of 286 and 386 chips.

The Nx586 has 473 pins, 3.5 million transistors, and will be available in versions that operate at 60 MHz and 66 MHz. NexGen said a 100-MHz version should be available by year's end. Unlike the Pentium, the Nx586 has a 32K on-board cache and a Level 2 cache controller built into the chip.

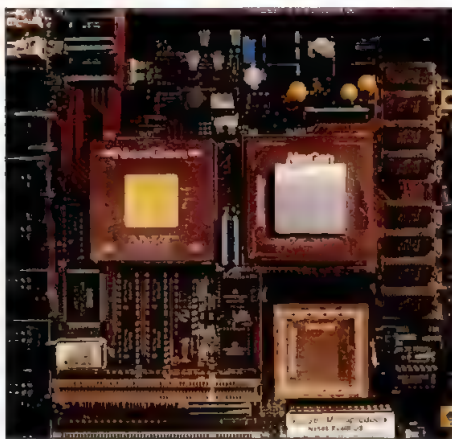
While we have not seen or tested a prototype system, NexGen claims the performance should be on a par with Pentium systems that have similar clock speeds. NexGen said a 60-MHz system will have a Winstone score of between 53 and 70, depending on the con-

figuration, compared with a Winstone score of 73 achieved by a typical 60-MHz Pentium system. A 66-MHz Nx586 system, NexGen claims, would have a Winstone score of between 60 and 80, compared with the 83 average of 66-MHz Pentium machines PC Labs has tested.

NexGen's goal is to be a price/performance leader. One of NexGen's first customers, Tangent Computer, even claims it can ship an Nx586-based system that will outperform a DX4/100 system yet cost less than \$2,000.

NexGen has a number of big-name investors who clearly believe it can challenge Intel. But one

investor, Compaq, which recently made waves when it signed a deal to use AMD parts, was mum when asked about plans to use NexGen's processor.—*Christopher Barr*



NexGen's first hurdle: mass-producing the Nx586.

Video Playback Takes Center Stage

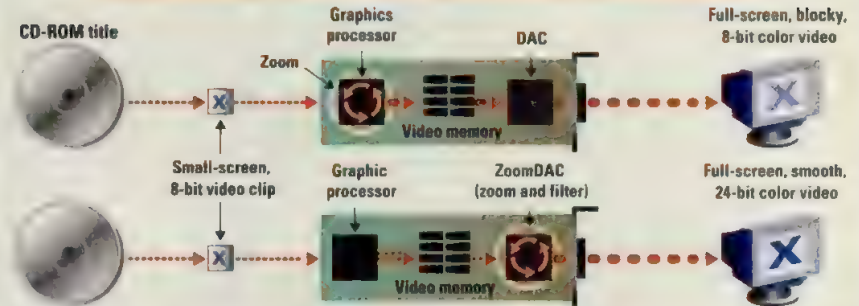
AFTER OVERESTIMATING CUSTOMER enthusiasm for making movies on the desktop, manufacturers are now redirecting development efforts toward viewing movies on the desktop. At least half a dozen vendors are now working on full-motion video-playback products that piggyback onto standard graphics accelerator designs. By this fall, you'll find several such boards for ISA-bus, VL-Bus, and PCI-bus PCs.

Video editing on your PC requires a motion-video capture board to bring in an analog signal from a video camera, VCR, or

Top Retail Software		
Current ranking	Last issue	Product/company
1	3	MS Windows for Workgroups 3.11 Microsoft Corp.
2	—	MS Money 3.0 for Windows Microsoft Corp.
3	7	Procomm Plus for Windows 1.02 DataStorm Technologies
4	—	WordPerfect 6.0 for DOS WordPerfect Corp.
5	—	Delrina WinFax PRO 4.0 Delrina Technology
6	—	Corel Ventura 4.2 Corel Corp.
7	10	QEMM 7.0 Quarterdeck Office Systems
8	15	Quattro Pro 5.0 for Windows Borland International
9	5	Stacker 4.0 Upgrade Stac Electronics
10	—	Close-Up Dual Pack 5.0 Norton-Lambert Corp.
11	2	MS-DOS 6.2 Upgrade Microsoft Corp.
12	—	MS Excel 5.0 for Windows Microsoft Corp.
13	8	MS Office 4.0 for Windows Microsoft Corp.
14	—	Procomm Plus 2.01 Datastorm Technologies
15	—	Stacker 4.0 Stac Electronics

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending March 25, 1994. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and can not be interpreted as a picture of the entire software market. Sales information adapted from a compilation by Ingram Micro.

Bypassing the Video-Memory Bottleneck



Scaling or zooming the video clip in the graphics processor requires raster operations (ROPs) between the graphics processor and the video memory. Zooming on the digital-to-analog converter (DAC) does not affect the video memory at all.

TV, compress it, turn it into a digital signal, and then capture the video to disk. After investing in capture technology, manufacturers discovered that the video-production market is small.

Video playback, or decompression is required to run multimedia CD-ROMs, is drawing a much wider market. This led VideoLogic, disappointed in sales of its Captivator board, to introduce the PowerPlay64 Digital Movie Accelerator, which plays back full-screen movies at the TV-quality rate of 30 frames per second (fps). Matrox Electronic Systems and IBM plan to use it in upcoming graphics accelerators. And Media Vision recently introduced the Pro Graphics 1024, a graphics accelerator that also supports 30-fps, full-screen video playback of AVI files.

Leading chip makers in the Windows accelerator market—ATI Technologies, Brooktree Corp., S3 Corp., and Tseng Labs—are targeting motion-video playback customers as well. Diamond Computer Systems offers Weitek's new Video Power playback coprocessor as a \$100 option. Like the Weitek solution, ATI Technologies' Video Wonder, S3's Vision/VA chip, and Tseng's Viper chip rely on designs that share the on-board RAM between motion video and graphics.

—Brad Stitwell

Zooming In on Full-Screen Video

IF YOU WANT FULL-MOTION, FULL-screen video, your best option today is to choose a hardware-assisted playback solution. The catch is that it takes a chip to decode the signal in real time. Chips cost money, and today there is no software equivalent. By the fall, however, there could

be a new inexpensive solution for full-motion video on the PC; and no, it's not another video-compression technique.

For a resolution of 1,024-by-768 with 24-bit color, the objective is to pump nearly 75MB of data per second from the CD-ROM to the screen through the PC's narrow byways. On its way, the video file encounters two speed bumps: moving from its originating location on the CD-ROM over the I/O bus into the video memory and the video memory itself.

An innovative idea under development at IC Works in San Jose, California, is the ZoomDAC, which can scale a small, low-resolution window and blow it up to full-screen size while retaining 30 frames per second with 24-bit color. A filter feature then smooths out blocky images.

Hardware scaling, or "zooming," is not new, but its tradeoffs have been blocky images and choppy motion. Scaling normally takes place either in conventional system memory or video memory, but then the file gets hung up in the I/O and video bandwidth bottlenecks. The ZoomDAC zooms in on the video at the last possible moment, right before it's displayed on-screen. Think of it as putting a magnifying glass to a small video window and enlarging it to fill the size of the screen.

One benefit to executing the zoom on the DAC is that it frees the video memory to work on other tasks. Normally, the additional job of scaling adds more ROPs (raster operations) for the graphics processor to perform, slowing things down. Another benefit to building this feature into the DAC is the ability to perform real-time zooming with no rewrite delays.

Manufacturers can integrate the ZoomDAC on both low-cost DRAM-base graphics accelerators and VRAM-based boards. IC Works expects to ship the ZoomDAC sometime this summer.—Brad Epranian

Briefs

YOU CAN GET IT FREE. MOSAIC, A GRAPHICAL front-end to the Internet, is free, but a PC-specific version will be offered for sale by Quarterdeck Office Systems (310-392-9851) later this year. Why pay for it? You'll get multimedia viewers and tech support.

IS YOUR JOB SECURE? THE TURNOVER RATE for chief information officers was 18.8 percent in 1993, up from 17.5 percent in 1992. Meanwhile, the proportion of staff in communication and network management rose from 7 percent to 10 percent, reports a survey of 400 CIOs in major North American companies conducted by Deloitte & Touche.

ATTENTION SPORTS FANS: ESPN AND PRODIGY have teamed up to launch ESPNET, an interactive sports network that offers late-breaking news, inside info, a BBS, photos of key plays, and a sports database. And armchair travelers can now visit the Travel Resource Center, a new Internet service that offers 27 on-line country guides, international news, travel magazines, and travel planning information. Call O'Reilly & Associates at 800-338-6887 or send e-mail to the Global Network Navigator at form@gnn.com.—Carol Levin



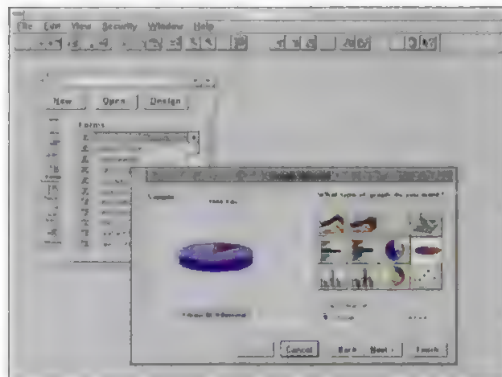
Hot Summer for Databases

WINDOWS-BASED DATABASE managers are undergoing a major makeover this year. An old favorite is disappearing, another is reappearing, and new products are on tap. Software Publishing Corp. decided to stop development of SuperBase and Symantec says that despite the rumors, it will continue to sell and support Q&A for Windows. But the biggest overall change is that tools that used to be only in the hands of professional programmers are making their way to end users, without sacrificing any of their power to access corporate data.

Databases about to be released may offer the best balance yet between ease of use and power. Microsoft recently shipped Access 2.0, which adds Wizards to walk you through the creation of a table. It also bolstered the developers' tools and added its Rushmore technology (inherited from Fox Software) to speed query performance. Powersoft Corp., which makes PowerBuilder, recently shipped a desktop version for client-server application development.

This should be a hot summer for hot databases. In June, Borland, which bought Ashton-Tate in 1991, will release the long-awaited dBASE for Windows. Lotus's June plans include the release of its easy-to-use Approach 3.0, which is expected to have

better integration with Lotus Notes and Lotus 1-2-3. Later this summer, Computer Associates will weigh in with CA-Visual Express, its entry in the Windows client-server



Microsoft Access's Wizards help database newcomers.

database category. Computer Associates is putting an emphasis on ease of use and intends CA-Visual Express to be used as a desktop query and reporting tool. And sources say Clarion and Oracle are readying database desktops.

Most of these databases include SQL engines that allow a desktop client to access data stored on a server, mini, or mainframe. Both CA-Visual Express and PowerBuilder Desktop use the Watcom SQL engine and have Open Database Connectivity (ODBC) support that lets you connect to a number of different databases. According to officials at Lotus, the SQL access in Approach has been tweaked to become even faster.

—Christopher Barr

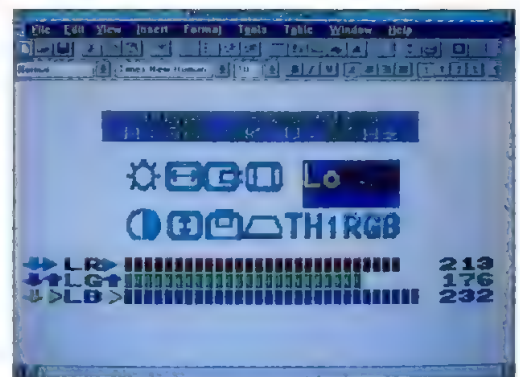
On-Screen Monitor Utilities

HERE'S AN IDEA WHOSE TIME HAS come. Monitor designers are finally adding on-screen menu controls to their new models. They'll remind you of the on-screen indicators you get with your TV and VCR.

Last fall, ETC Computers introduced one of the first hardware-based on-screen menu controls systems in three of its ViewMagic monitors. All of the software needed to run the screen controls is stored in ROM on board the monitor. ETC's monitors use six pushbuttons on the front panel to control brightness, contrast, color matching, image positioning, sizing, and rotation. As you adjust a control, the horizontal bar and numerical value display on-screen changes. You can view all adjustments on a single "page" that pops up on the ETC monitor's screen.

Now, other companies are following suit. Nokia Consumer Electronics' new models have on-screen controls for brightness, contrast, picture position, picture height and width, degaussing, and other adjustments. The ViewSonic 17G from ViewSonic and the AcerView 76i from Acer America, both of which use hardware-based menu systems similar to Nokia's, are the first 17-inch monitors with on-screen controls to sell for less than \$1,000.

There are real advantages to software-based on-screen controls: They're less expensive than the ROM-based approach and they're easily upgradable since the screen controls are stored on floppy disks. You install them as you would video board drivers. Mitsubishi Electronics America, which developed software-based controls, includes such a disk free with its Diamond Pro 21T and sells it for \$19.95 with the Diamond Scan 17FS. MAG InnoVision has pledged to follow this route as well.—Brad Stulwell



ViewMagic monitors have software-based controls.

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ZEOS dual scan screen (left) fires up rich, vibrant colors while standard passive matrix screen (right) produces faded and dull colors. Photos are not retouched.

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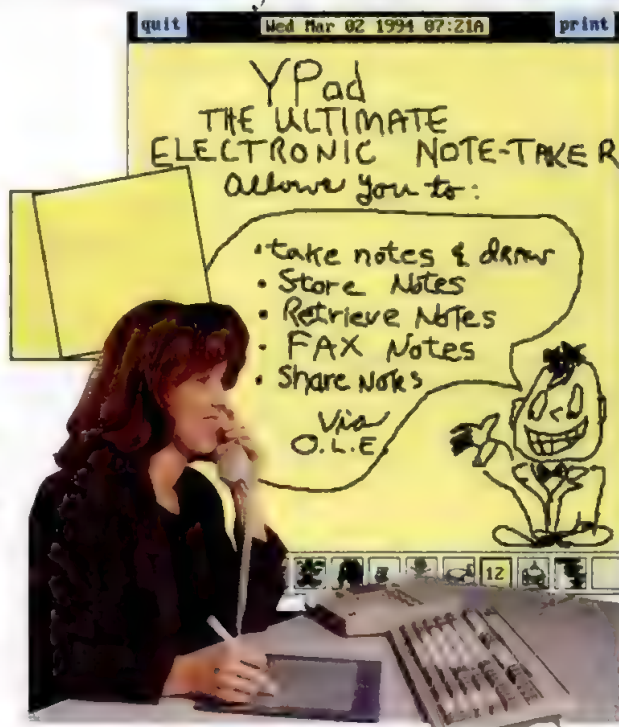
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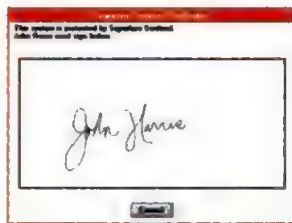
you really getting paid enough to suffer? 56% of all OSHA reported injuries are RSI, or Repetitive Stress Injuries. The recommended physical therapy for wrist and tendon problems is making a fist. Kind of like you'd do holding a pen. Pen computing is a very healthy complement to your computer keyboard. And to your life.

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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

■ Welcome to the Three-Axis World

Enter the 3rd Dimension with trueSpace and Visual Reality

Fast systems with high-performance graphics accelerators have made it possible to create stunning 3-D images and animations on PCs, but steep learning curves and high software prices can be daunting. Now, easy-to-operate 3-D applications from Caligari and Visual Software are poised to bring 3-D graphics to the masses.

trueSpace

BY LUISA SIMONE

Caligari trueSpace for Windows makes professional-quality animation more accessible to the average computer user in two different ways. A \$795 price tag makes it less expensive, and it provides an integrated, icon-driven, natural interface that turns the difficult tasks of 3-D modeling, rendering, and animation into creative play. (trueSpace is available for \$499 until May 31.)

The first thing you notice about trueSpace is that it doesn't have separate modules for 2-D outlining, 3-D modeling, rendering, and animation. All of the program's functions are part of a single unified work area. The dual benefits of increased efficiency and instant feedback quickly become clear. For example, to see how the addition of a colored spotlight affects one particular object in a scene, you simply click on the object and render it. There is no need to exit to a separate module, nor must you wait for the entire frame to be rendered. trueSpace can render

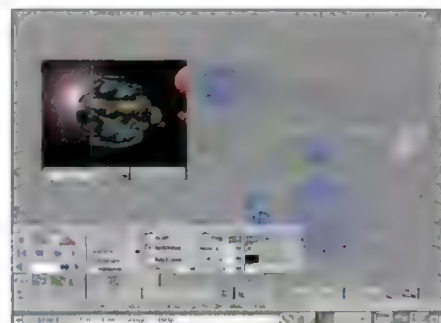
individual objects (and even individual faces of an object) within a wireframe view.

The second thing you notice about trueSpace is that it is totally icon-driven. In fact, except when opening and saving files, you don't use menus at all. The program's designers have done a good job of identifying the multitude of icons with clearly differentiated designs and a help bar that identifies an icon before you click on it.

But be prepared for an initial period of confusion when it's all too easy to click on the wrong icon.

For example, the only difference between the icon for moving objects and the icon for moving individual points is the color. One piece of advice: If you work in 1,024-by-768 resolution, you'll find that all of the primary icons fit neatly in a single row along the bottom of your screen. Working at a lower resolution means that icons are stacked in multiple rows, eating up valuable screen space.

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ANIMATION: trueSpace gives you access to keyframe- and path-based motion effects.

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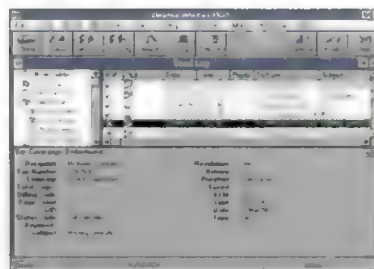
■ New Talents, Improved Interface

Better-Looking WinFax Dials Up E-Mail

BY DAVID HASKIN

The designers of WinFax PRO 4.0 understand a basic truth of modern computing life: PC users send and receive messages in many ways and from many different places. If you use multiple methods of communicating, and particularly if you are a mobile communicator, WinFax PRO (\$129) is a must-have product.

The new WinFax PRO not only handles faxing but also can transmit faxes and binary files simultaneously using the binary



FOLDERS: WinFax PRO's new system of storing messages uses folders.

file transfer (BFT) protocol (see the sidebar "The BFT Advantage"). Additionally, WinFax

PRO can serve as a front end for VIM- and MAPI-compliant electronic-mail systems, which simplifies life for mobile users by letting them create different configurations for different locations.

INTERFACE MAKEOVER

Beyond its new communications and travel skills, though, experienced WinFax users will first notice that Delrina has eliminated the dis-

Continues on page 40

First Looks

trueSpace

CONTINUED FROM PAGE 37

Given those few caveats, trueSpace's icons will let you navigate quickly through all of the program's many features and easily access sophisticated functions such as hierarchical relationships, object deformations, and UV mapping coordinates.

EASY WIREFRAMES

The third thing you notice is that you manipulate wireframe objects in a very direct, very intuitive fashion. trueSpace mimics the real 3-D world very convincingly. The program changes coordinate systems on the fly, depending on the current tool. Hence, the object move tool automatically invokes world coordinates (because in real life you move objects in relation to a larger space), while the object rotate tool switches into object coordinates (because we normally spin objects around their individual axes).

trueSpace's real-time display allows you to see the results of your actions immediately. If you inadvertently move an object in the wrong direction, you can correct it without waiting for a screen redraw.

And where other programs force you to get a degree in engineering to understand the complex geometry of three-dimensional objects, trueSpace lets you edit wireframes with simple click-and-drag motions. If you've ever worked with warping envelopes in a 2-D drawing package (like CorelDRAW), you will instantly feel familiar with trueSpace's free-form deformation lattice, which is basically a 3-D bounding box that can be subdivided and interactively reshaped to transmogrify objects.

The wireframe view in trueSpace also gives you the ability to interact with high-end functions. Instead of expecting you to understand UV mapping coordinates on a conceptual

level, trueSpace gives you a wireframe representation of planar, cylindrical, or spherical maps that shows you exactly how a texture will be projected onto the surface of the selected object. You can then use the standard object move and object rotate tools to fine-tune the mapping relationship.

HIGH-END ANIMATION

Animating your movie is a deceptively simple process, because trueSpace allows you to switch back and forth seamlessly between keyframe- and path-based animation. The only real problem we ran into during testing was centered around screen refresh. Basically, trueSpace displayed bounding boxes instead of complex geometry even on a

16MB system, making it difficult to preview complex wireframe animations prior to rendering.

The tight integration among the program's various functions has really big payoffs at animation time. For example, the deformation lattices can be detached from their associated objects. Like lights and cameras, the deformation lattices exist in the wireframe view and influence the final rendered animation. Moving an object through a deformation lattice is a great, easy way to generate a morphing effect over several frames.

RENDERING

You can either render your creations as still frames (in .BMP/.DIB and Targa formats) or create .AVI movies (using Micro-

soft Video 1, Intel Indeo, or Cinepak compression). Formats such as TIFF and the Autodesk .FLI and .FLC formats are notably absent but will be added to an upcoming release.

The rendering engine itself is based on proprietary code. While this doesn't deliver the superior procedural renderings of products like Pixar RenderMan, it does provide for speedy previews on an object-by-object basis. Indeed, using the unique Paint Face tool, you use a "paintbrush" to apply a different material to each face of an object. Once again, creating new materials—complete with sophisticated texture maps, transparency maps, bump maps, reflection maps, and ray-traced shadows—is as easy as clicking on a series of icons.

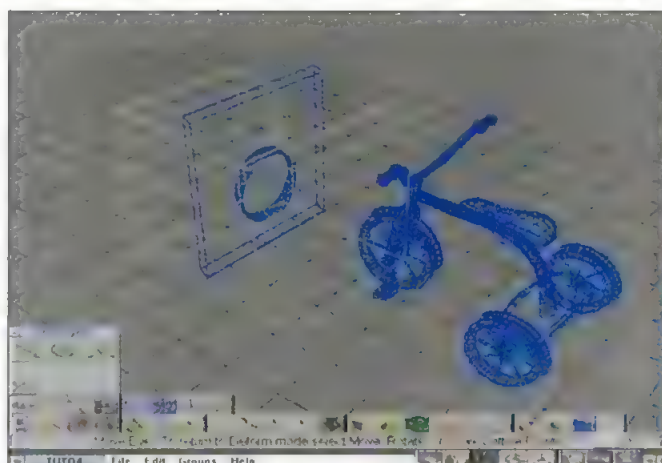
At the moment, trueSpace ships with only a handful of sample material libraries and a few clip objects. But a CD-ROM with additional textures and objects will be shipped free to registered users.

A quick inspection of the program's 3-D import filters (.DXF, 3DStudio, Wavefront, and Lightwave) proves that despite its low price, Caligari expects trueSpace to compete with high-end 3-D modeling programs.

Without dimensioning tools, numerical inputs, or accurate alignment functions, however, trueSpace may not be well enough equipped to woo engineers away from their favorite modeling programs. But video artists and multimedia producers who are looking for movie magic will be thrilled with the broadcast-quality special effects that can be created easily with this inexpensive package.

• List price: Caligari trueSpace for Windows, \$795. Requires: 4MB RAM (16MB recommended), 6MB hard disk space, Microsoft Windows 3.1. Caligari Corp., 1955 Landings Dr., Mountain View, CA 94043; 800-351-7620, 415-390-9600; fax, 415-390-9755.

Circle 432 on reader service card



MORPHING: The tricycle will be squashed and stretched as it passes through the deformation lattice.



BIT BY BIT: trueSpace can render individual objects within a wireframe scene for instant feedback.

Visual Reality

BY JAMES KARNEY

Visual Reality for Windows is a collection of five modules that make up a complete 3-D toolkit. You also get two CD-ROMs containing a wide variety of 3-D clip art and images for use as fills and textures.

Visual Reality is relatively easy for the part-time or occasional 3-D artist to use. Drag-and-drop operations, button bars, and context-sensitive help get the new user through the transition between 2-D and 3-D operations, and a well-designed set of tutorials and manuals go a long way toward taking the mystery out of working in three dimensions.

RENDERIZE LIVE

The hub of the program is Renderize Live, a much improved version of Visual Software's Renderize for Windows that uses a studio-like metaphor. You adjust lighting and move a virtual camera around 3-D objects with your mouse to get just the right view and effect. Virtual Reality gives you almost total control over every aspect of the virtual 3-D world, including surface materials, fills, object shading, color, and texture.

A master window, called the Viewport, provides WYSIWYG views of your work as well as access to the program's main tools. Some controls are very intuitive, but others require practice for those not used to a 3-D workspace. As you change from one mode to another, toolbars on the top of the Viewport change. The status bar at the top of the window provides information about how to use the tool currently under the mouse cursor. In order to act on objects and views, you drag them from "wells" into the main part of the Viewport.

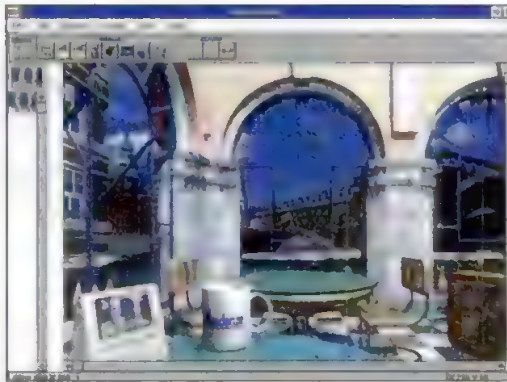
Let's say you want to render an image of a room. You give furniture wood finishes with a polished sheen by manipulating the attributes of the material.

The 32-bit color model used by Visual Reality can also make a material such as glass transparent.

COOL LIGHTING EFFECTS

The lighting controls are excellent. You create and position all types of lights, from narrow spots and barn doors to complex soft boxes—virtually anything a photographer could imagine. While 2-D objects can be used in Virtual Reality projects and even placed in scenes to cast realistic shadows, they can not be rotated for different views the way 3-D objects can.

Lights and a camera can move all around objects, whether freely on all axes or rotated around a fixed target. The view



VISUAL IMAGE: Edit bitmapped images and use them as objects in photorealistic collages.

views, and assemble the presentation.

You use the Visual Player module to run .FLI and .FLC files, and you can also run presentations using Autodesk's Animation Player and the Windows Media Player. Individual drawings are exportable in .BMP, EPS, .GIF, native

ated in other applications for use in your projects. The two CD-ROMs included with the program contain over 500 images along with common textures and backgrounds.

VISUAL IMAGE

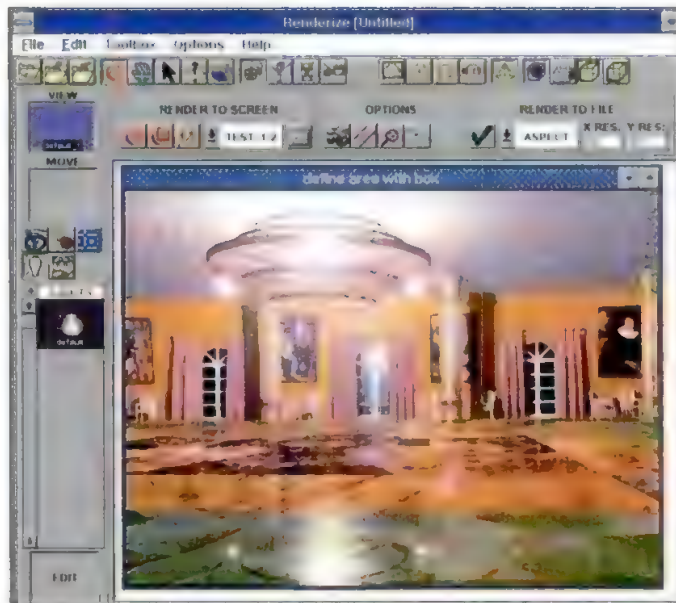
Visual Image is a multi-layer bitmap editor that has many of the same tools as paint programs. The module uses the same combination of toolbars coupled with drag-and-drop operations. It has two modes: The Image Mode works much like any bitmap editor, and the Object Mode is used to create collages and work on individual images within a collage.

Visual Font is a slick utility that can extrude text from any Windows TrueType font or symbol collection into a 3-D object, which you then edit in Renderize Live. It took us just a few minutes to create a smooth animation of a logo drawn using Visual Font against a bitmapped background.

Keep in mind that Renderize Live demands heavy-duty hardware. It's a full-blown 32-bit application that pushes Windows and DOS to their limits. While the program will run on a 386 with a coprocessor and an 8-bit graphics card, it really needs a 486 with a fast hard disk and a 24-bit true-color display adapter to match.

Visual Reality's modules are very well integrated and together constitute a powerful graphics and animation tool. Given its price point and users' increasing interest in photo-realistic imagery, you can bet that it will soon find its way onto many desktops.

• List price: *Visual Reality for Windows*, \$595. Requires: 8MB RAM, 20MB hard disk space, SVGA color display, DOS 5.0 or later, Microsoft Windows 3.1. Visual Software Inc., 21731 Ventura Blvd., #310, Woodland Hills, CA 91364; 800-669-7318, 818-883-7900; fax, 818-593-3750. Circle 432 on reader service card



RENDERIZE LIVE: This image by Frederic Bertrand shows the flexibility of Visual Reality's 3-D rendering tools.

from the camera is the one that will be seen by the viewer, filled, and lit, after you render the view. This is especially useful when creating animations. Just move the camera along a path and note your keyframes, then tell Renderize at what speed to play the file. The program will calculate the steps, render the

.RAW, SUN Raster, Targa, and TIFF formats.

You bring wireframe objects into Renderize Live from AutoCAD .DXF or waveform .OBJ files, as well as from the program's own Visual Model wireframe designer. This module lets you create 3-D models, as well as edit 3-D clip art or elements cre-

WinFax PRO

CONTINUED FROM PAGE 37

jointed interface of previous versions. For example, you used to store incoming and outgoing faxes in logs, but you archived and compressed faxes in special files that were clumsy to create and access.

Now, as in many network e-mail packages, WinFax PRO's send and receive logs are folders that you supplement by adding your own system of archive folders. To archive a message, you drag it from the send or receive log to a folder. If the message is a fax, WinFax PRO automatically compresses it.

Similarly, you were once required to navigate

different interfaces to manage cover pages, phone books, and attachments. Now, you manage those resources with folders and subfolders that act virtually the same way as those used for storing messages.

This interface uniformity lets you use the same resources for all types of transmissions. A simple benefit of the uniformity is that you store all messages in the same folders and subfolders, no matter what the transmission method. You use the same phone book for all message recipients no matter how you send messages to them, and you can designate two primary methods of transmission for each person in your phone book.

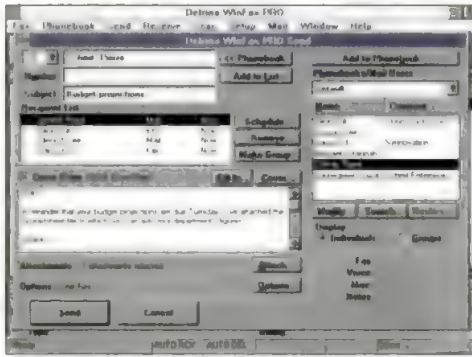
Also, you can now forward a received fax as an e-mail message and recycle attachments you receive by one transmission method for use with messages you send by other methods.

COMMUNICATIONS CENTER

WinFax PRO's abilities as an e-mail client are thorough, helping you create, send, automatically retrieve, store, and forward e-mail messages and attachments. You can address e-mail messages either from WinFax

PRO's address book or from your normal e-mail address book. Using your e-mail address book is faster, but you must use WinFax PRO's to send the same message to e-mail, fax, and BFT recipients.

Delrina has made WinFax PRO 4.0 a dream for mobile users. The most powerful of its



MAIL CALL: WinFax PRO lets you send the same message to multiple recipients.

new travel-oriented features is its ability to create configurations for three separate locations. This means, for example, that WinFax PRO can automatically dial one prefix to get an outside line when you are in the office and another prefix to disable call-waiting at home. When you change locations, you switch configurations in an easily accessed dialog box.

You can leverage these location-specific configurations to vary the way you transmit messages to specific individuals, depending on your location. Thus, you can use WinFax PRO

to communicate with a work colleague by e-mail when you are in the office and by sending faxes to that person when you travel. It's easy to set up in the phone book record for each individual.

Another traveler-friendly feature is a beautifully designed dialog box that walks you through the process of using your telephone credit card when dialing out of virtually any phone system. Also, Delrina has finally added the ability to forward incoming faxes to a designated location, a feature included in several competing products.

SPRUCING UP

Delrina has refined many other features in WinFax PRO without significantly upgrading them. Notably, viewing faxes now occurs almost instantaneously rather than after the 5-to-8-second wait imposed by the previous version.

One welcome addition to the annotation capabilities is a dialog box for quickly adding commonly used graphics images to faxes, such as electronic versions of your signature. Version 4.0 has a new optical character recognition (OCR) engine, and there are some minor improvements to the OCR interface, but OCR accuracy hasn't improved much.

Only a few areas still need work. One missing feature for travelers: retrieval of faxes from

remote locations. Although other fax products can do this, Delrina pulled the feature from WinFax PRO just prior to release. Delrina does promise to include it in an interim release.

Despite usability improvements, WinFax PRO could still handle attachments you add to faxes better. Specifically, it's still hard to change the order of pages in fax attachments, a common need when assembling faxes from many sources.

Because Delrina persists in using its own proprietary format for fax images rather than the more commonly used TIFF format, connectivity with other products is sometimes cumbersome. For example, if you need more annotation tools than WinFax PRO provides, you first must save your fax to a different graphics format before you can alter it with a third-party image editor.

Like the best of the new generation of communications products, WinFax PRO 4.0 reflects the more complex realities of modern communication. Fortunately, it makes those complexities simple to deal with.

• **List price: WinFax PRO, Version 4.0, \$129; upgrade, \$49.** Requires: 4MB RAM; 10MB hard disk space; Microsoft Windows 3.1 or later; Class 1, Class 2, or CAS fax modem. **Delrina Corp., 6830 Via Del Oro, #240, San Jose, CA 95119; 800-268-6082, 408-363-2345; fax, 408-363-2340.**

Circle 403 on reader service card

■ The BFT Advantage

The speed benefits of sending binary files and bitmapped faxes simultaneously with WinFax PRO's Fax-a-File feature are obvious. Binary file transfer (BFT) is one emerging standard that deserves to catch on. In our tests, a file containing a 12-page word processing document took about 2 minutes to send via BFT but about 12 minutes to send as a traditional fax.

WinFax PRO supports several flavors of BFT: generic versions for Class 1 and CAS modems, a version that compresses files (but works only with other WinFax PRO 4.0 users), and Microsoft At Work (MAW). MAW is a

series of standards that has received much attention for its potential to link computers with office machines, such as photocopiers and standalone fax devices. In this context, MAW is essentially BFT with additional security capabilities, such as encryption.

On the downside, BFT works only when you're communicating with other software and devices that support it. As of this writing, such products are few, although several BFT-complaint products are on the way. Another potential shortcoming is that BFT currently works only with Class 1 and CAS fax modems, which are common but will eventually be out of date. It is uncertain how future fax modem standards will handle BFT.—DH

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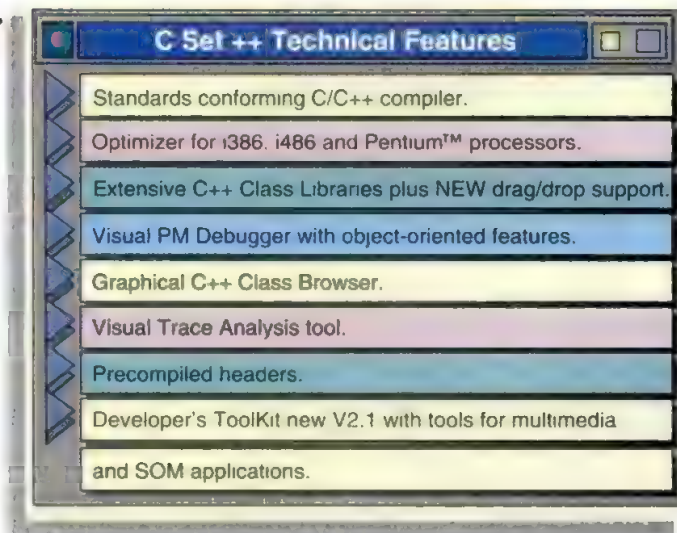
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■ Fonts

Type Casting: FontChameleon Blends Fonts

BY LORI GRUNIN

The latest addition to Ares Software's pleasantly over-stuffed bag of font tricks is FontChameleon for Windows 3.1, a \$295.95 utility for building custom variants of fonts and combining pairs of fonts. But despite its extremely clever technology, Ares still needs to iron out a few kinks in this oth-

erwise good first effort.

FontChameleon's underlying technology consists of a master outline and about 200 font descriptors—sets of parameters used to shape the master outline into traditional font outlines such as Bodoni, Century, and Franklin Gothic.

The program lets you alter the weight, x-height, slant, track, and degree of condensation or

expansion of the font descriptor. You then build the font and generate print-and-preview enabled TrueType or Type 1 font files, with full control over font family and subfamily naming conventions. In addition, FontChameleon lets you combine any

two descriptors in order to generate a new font outline.

This approach has several advantages. It's a compact method for storing font information and a clever way to create portable fonts. For instance, you can send just the descriptor (which takes less than 5K of disk space) to the document recipient. As long as the recipient has FontChameleon—it comes in a Macintosh version as well—he or she can build the font. The program also lets you import AFM font metrics into any descriptor for cases where you need to maintain the line breaks in a document that uses a font you or your service bureau might not have.

While it's very easy to use, a product such as this one is only as good as its descriptors and blending algorithms. The descriptors fare pretty well. They generate a reasonably broad and attractive set of fonts (you can't

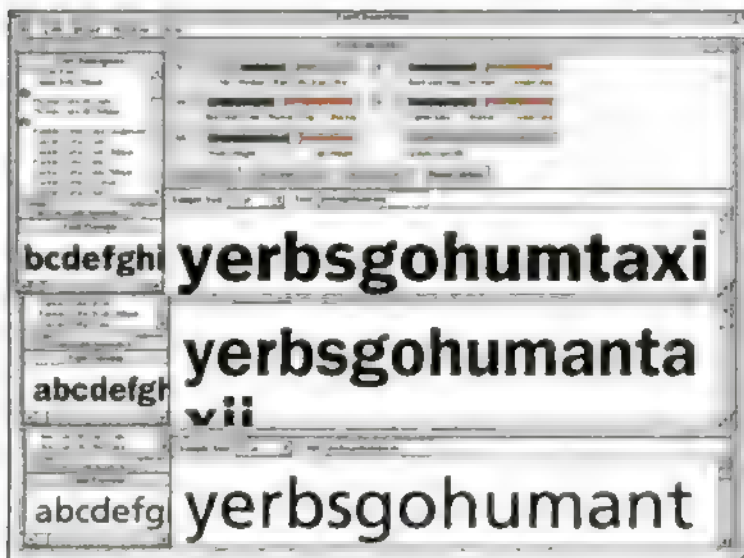
use your own TrueType or Type 1 outlines), and Ares has font designers working on more descriptors for future release.

The blending quality, on the other hand, needs some improvement. The two new font outlines we created, one serif and one sans serif, have serious artifact problems, ranging from wobbly diagonal strokes on the capital M to outline malformations at the bases of several letters.

For now, the limited selection of descriptors and poor blending makes FontChameleon unsuitable for graphic designers, but business users with font substitution needs or nonprofessional desktop publishers who want to experiment will find it useful.

• **List Price:** *FontChameleon for Windows 3.1*, \$295.95. Requires: 2MB RAM, 2MB hard disk space, Microsoft Windows 3.1. Ares Software Corp., 565 Pilgrim Dr., Suite A, Foster City, CA 94404; 800-783-2737, 415-578-9090; fax, 415-378-8999.

Circle 422 on reader service card



IN THE BLENDER: The top font is a combination of the other two.

■ PCMCIA Modems

WorldPort 14.4 Fax/Data Modem: Install with Care

BY MITT JONES

For some, the \$339 WorldPort 14.4 Fax/Data PCMCIA Modem will prove to be a terrific bargain. For others, this V.32bis offering from U.S. Robotics may well be a chronic frustration. Which group you belong to depends primarily on whether you need to use the Phoenix card and socket drivers provided with the modem.

The WorldPort's documentation covers installation procedures for 26 notebooks from 15 vendors, including Compaq, Gateway, IBM, NEC, and Toshiba. Installing the modem on machines from seven of the vendors—including IBM and Toshiba—requires using Phoenix PCMCIA drivers and mak-

ing manual changes to your CONFIG.SYS file.

In the case of one of our test machines, the Toshiba T1900, installation was far from trouble-free. After initial success, multiple file-corruption problems kept Windows from loading. To get the modem running again, we had to delete the Phoenix drivers, reinstall them, copy them into the Windows \SYSTEM directory, and configure the notebook to use expanded memory. The modem also failed to initialize each time we brought the Toshiba out of sleep mode. A U.S. Robotics representative reported that a forth-

coming driver eliminates the need to configure for expanded memory.

U.S. Robotics recommends using the SystemSoft drivers provided with the NEC Versa when installing the modem on that machine, and the WorldPort performed flawlessly running with these drivers. But when we configured our test Versa to run the Phoenix software provided by U.S. Robotics, the modem wouldn't respond.

While the system speaker does a decent job with dialing and connection tones, it seems to omit the dial tone altogether. According to U.S. Robotics, buyers who desire a higher-quality speaker connection can return the modem to U.S. Robotics for a free

FlashRAM update.

On the brighter side, U.S. Robotics has come up with a novel and appealing solution to the PCMCIA phone-jack problem by outfitting the WorldPort with a single jack that resides within a 0.6-inch-high plastic wedge and plugs directly into the modem card. This solution isn't quite as convenient as the pop-out jack of the Megahertz Xjack modem, but it's a better alternative to the typical plug-in wire adapter.

The WorldPort Fax/Data PCMCIA 2.0 Modem should sell for an almost irresistible street price of under \$250. If you can get it to run with your notebook, it should prove to be a capable performer.

• **List Price:** *WorldPort 14.4 Fax/Data PCMCIA Modem*, \$339. U.S. Robotics Inc., 8100 N. McCormick Blvd., Skokie, IL 60076; 800-342-5877, 708-982-5010; fax, 708-982-5235.

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CONNECT:

The modem goes in a Type II slot.

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1,400,000

1,200,000

1,000,000

800,000

600,000

400,000

200,000

Close-Up 5.0

pcAnywhere
for Windows 1.0

CarbonCopy
for Windows 2.11

WinBench scores
(average of 10 runs):
Close-Up 1,613,118
pcAnywhere 194,093
CarbonCopy 168,397

WinBench™ 3.11 by Ziff-Davis Labs Tests Remote Windows™ Speed

This graph shows the speed of the three leading remote control programs when transferring Windows screens. As you can see, Close-Up handles more pixels, faster, meaning you spend less time waiting for Windows screens.

The industry standard test, WinBench 3.11, is perfect for testing the speed of remotes. It is an accurate measure of video throughput. Video throughput is the limiting factor in remote operations, because remote programs must transmit Windows video functions from one PC to the other.

New Remote Software Sets Windows Speed Record

Communicate Faster & Easier

Close-Up® lets you communicate faster & easier with five exciting technology firsts.

Close-Up is the only remote communications software that won both PC Magazine's coveted "Editors Choice" and PC World's "Best Buy" awards. Now Close-Up has a new faster & easier version that allows you to view and control another PC by modem as if you were there!

Technology Firsts

1. AI Video Compression
2. Photographic Memory
3. Non-Intrusive Technology
4. Expert System
5. Video Translation

Why Is Close-Up So Fast?

Close-Up learns as it works. It uses AI (Artificial Intelligence) to compress all Windows video function calls. That's why Close-Up does so well in Windows

Benchmark tests (see WinBench 3.11 chart).

Close-Up uses its revolutionary Photographic Memory™ so that once Close-Up has seen all or part of

a Windows screen, it's memorized. Then as screens change, Close-Up only transmits new unmemorized data. Incredibly, with this technology Close-Up gets faster & faster the longer you use it.

What Remote Companies Haven't Told You

Other remote programs permanently slow Windows and usually reduce your video resolution and depth of color, even when they are not in memory. That's because they permanently change your system.ini file. Close-Up's breakthrough Non-Intrusive Technology does not modify any of your sensitive Windows files including the system.ini. Close-Up is the only remote that when not in use, allows Windows and your PC to run at normal optimal levels.



Expert System Makes Communications Easy

You don't have to be a communications expert to get the results of one. Close-Up has an Expert System that automatically analyzes system components and configures your system for optimal speed.

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We invite you to reproduce this test. We used two identical Gateway 4DX2-66V's with 66-MHz Intel 486DX2-66 CPUs, 16 MB RAM, 256KB RAM cache, 340 MB HD, IDE controller, no hardware disk cache. Video: Local Bus ATI Ultra Pro with 2MB VRAM, 640 by 480 pixels, 16 colors, VGA DRV dated 3/10/92. Monitor 72 Hz. MS-DOS 5.0, SMARTDRV 2 MB cache. Modems: two 14,400 baud V.32bis. Test performed without verification by Ziff. All products are shipping versions. WinBench trademark of Ziff Communications Co. Windows trademark of Microsoft Corp.

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■ Databases

Microsoft Goes After dBASE Users with FoxPro 2.6

BY SAL RICCIARDI

If you're a dBASE user and you haven't made the switch to FoxPro, Microsoft is looking for you. FoxPro's latest release, Version 2.6, includes a number of new features designed to make moving to FoxPro easy.

The first is the Catalog Manager, an application you'll find familiar if you've used the dBASE Control Center. A catalog is a table that holds the names and locations of all the tables, queries, reports, screens, labels, and programs belonging to a particular application. The Catalog Manager lets you create catalogs and work with the files referenced within them. It also organizes your applications' components into a central place from which you work.

For example, you can create, run, or modify a custom screen directly from the Catalog Manager, or browse a table, create a report, or modify a query. The Catalog Manager does not, however, replace FoxPro's Project Manager, which tracks all of an application's components and builds a completed application, recompiling new program files as necessary.

When working with the Catalog Manager, FoxPro automatically reads and converts your dBASE catalogs and each of your component files. The new Auto-Migrate feature converts your dBASE forms, tables, indexes, queries, reports, and labels when FoxPro senses that you're attempting to use a dBASE file within the catalog manager.

New to this release are a useful collection of Wizards—dialog-driven applications designed to make common tasks easier to perform. With each Wizard, you just answer a few questions and the Wizard uses your responses to perform a task.

The Table Wizard lets you choose columns from approximately 50 different predefined tables, including Order Details and Invoices or Contacts, to name just two. From each sample table you select columns to include in your own table. As you work, you accept a column as is or modify its name and characteristics. After choosing the columns, you determine the sort order of the table by selecting up to three columns to sort on. FoxPro creates the table and creates a composite index tag on those columns you choose.

Three new query Wizards make creating queries easier. The SQL Query Wizard creates

can browse or use as the source for a report, but that you can't edit. The Updateable Query Wizard, on the other hand, generates a query result that you edit by setting relations between

SCREEN WIZARD: Create attractive multiuser screens in one of several formats.

tables using the SET RELATION command.

The Client/Server Query Wizard lets you connect to any ODBC data server and use SQL to retrieve data. This Wizard is available only as part of the new FoxPro 2.6 Professional Edition, which combines FoxPro with all of its add-on developer toolkits at a very attractive price (\$695, instead of \$1,780 individually).

SCREEN WIZARD

The new Screen Wizard generates a FoxPro screen using any one of several different styles. The result is actually a mini-application. You use it to edit, add, delete, print, display, and navigate through records in your table. To create a screen, you simply answer questions about the table and the sort order and then select an overall style and a button type (text or graphical).

While the Screen Wizard is useful, it would be more effective if it asked you to choose an optional primary key field and then generated code to prevent

the entry of duplicate or null values into the chosen field.

REPORT ASSISTANCE

Three new report Wizards automate the task of creating attractive reports. The Report Wizard generates simple one-column reports, while the Group/Total Report Wizard creates a report that sorts records within up to three groupings, with optional totals and subtotals for numeric fields. The Multi-Column Report Wizard takes advantage of

FoxPro for Windows' ability to print multiple columns, generating reports that use one, two, or three columns.

FoxPro is still lacking in some areas. There's no toolbar or tool tips support. More problematic, and endemic to most Xbase products, is the lack of support for declarative data integrity rules and engine-based primary keys. Still, FoxPro 2.6 provides an easy transition for dBASE users and developers, and at Microsoft's introductory price of \$99, it's a real bargain.

• List price: *Microsoft FoxPro 2.6 Standard Edition for Windows*, *Microsoft FoxPro 2.6 Standard Edition for MS-DOS*, \$495 (\$99 until June 30, 1994). Requires: *Windows version: 4MB RAM, 10MB hard disk space, Microsoft Windows 3.0 or later. DOS version: 640K RAM, 10MB hard disk space, DOS 3.1 or later. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax, 206-936-7329.*

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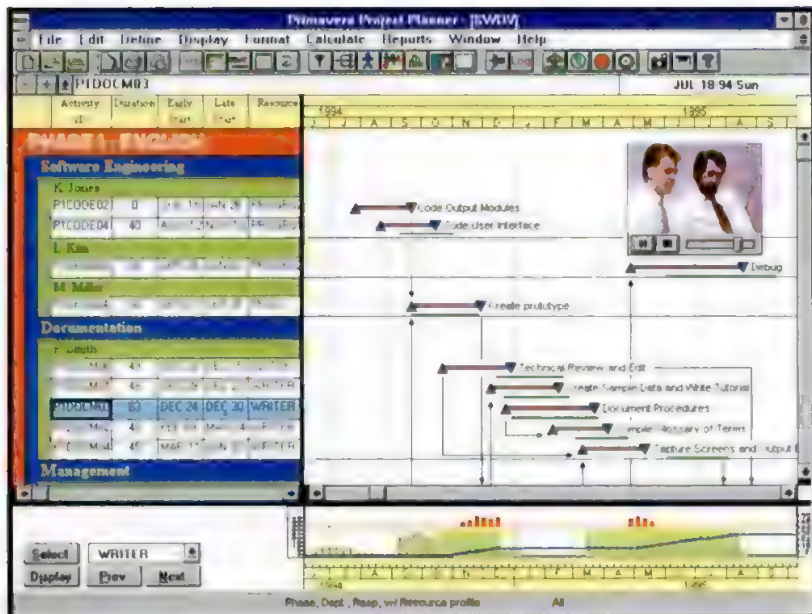
CATALOG MANAGER: Automatically reads and converts dBASE catalog files.

the same type of query that is generated by FoxPro's Relational Query By Example—namely, one that uses the SQL SELECT statement to do its work. You can use aggregate functions and can sort, filter, or group the query results.

The result is a new, temporary, read-only table that you

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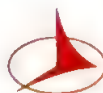
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■ Contact Management

ACT! 2.0 Adds Networking Tools and E-Mail Access

BY GREGG KEIZER

These days, it's not enough for a contact manager to keep tabs on names and addresses, write a letter now and then, and organize day-to-day life with a digital calendar. As contact managers proliferate, a credible package must also link you electronically with other people. Symantec Corp.'s \$279.95 ACT! 2.0 for Windows does just that. ACT! retains the structured contact-management characteristics of its predecessor as it adds impressive network functionality.

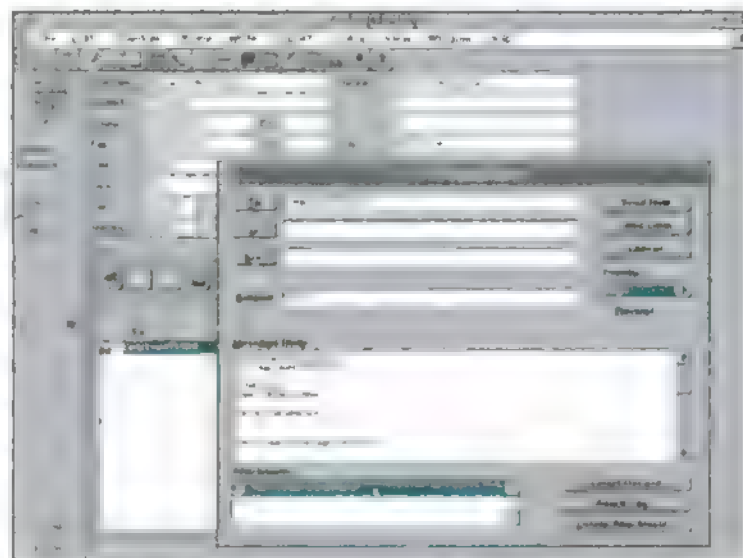
FAMILIAR SCREENS

On the surface, little has changed in Version 2.0. Two screens display the 72 fields that make up each contact's record. These fields can store two addresses; two alternate contacts; dates for multiple meetings, tasks, and calls; and e-mail addresses. The 15 user-defined fields record additional tidbits of information. Though you can't design your own layout, ACT!'s ten preset views range from a minimal Rolodex-like display to an all-encompassing spread best reserved for large monitors.

The interface relies heavily on point-and-click maneuvering, with a customizable toolbar, pop-up lists for fast data entry, and multiple windows that show everything from a contact's history to upcoming scheduled events.

ACT! continues this graphical approach with day, week, and month calendar views that highlight future

events. You schedule meetings, calls, and daily tasks by clicking on the calendar, and reschedule simply by dragging and dropping



BUILT-IN E-MAIL: ACT! 2.0's integrated e-mail lets you exchange bits and pieces of data.

the activity to another day. A notes window lets you attach free-form information to a specific contact.

An integrated word processor automates quick correspondence and conducts a mail-merge—complete with envelopes and labels—from any selected group of contacts.

You can also use ACT! in conjunction with WinFax PRO to send faxes; the former acts as an address book for the latter.

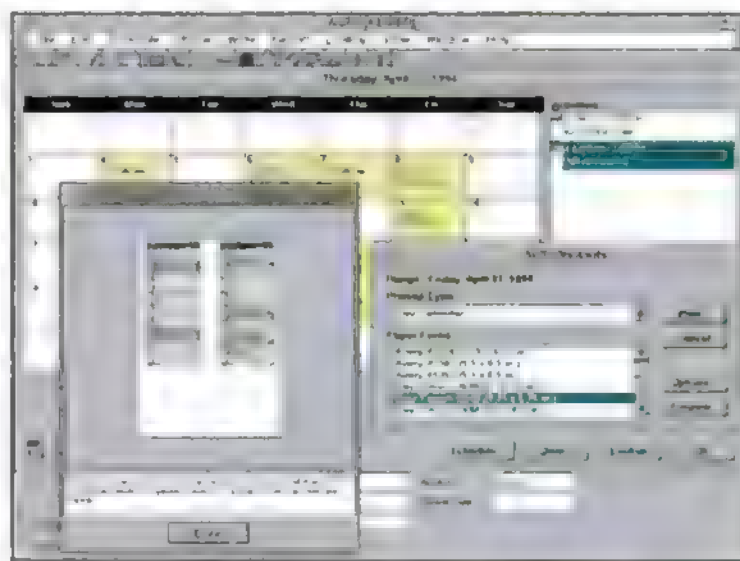
NETWORK SUPPORT

Under this familiar interface, though, Version 2.0 adds several important features to create a suitable workgroup application. ACT! now supports NetWare, LANtastic, and Windows for Workgroups networks. Multiple users can simultaneously share an ACT! database; its records lock as long as someone is editing

them. You can mark activities as public for sharing on the group's calendar and select individual records to be excluded from general view.

A triple layer of security, which is set by the network administrator with a network utility, limits access to the database. Privileges include a browse setting that allows for viewing only; database password protection is available as well.

Network installation is straightforward, and you can mix both standalone and network-licensed copies of the program in a single configuration.



NEW OUTPUT: Additional print choices in ACT! 2.0 generate 20 paper-based formats.

INTEGRATED E-MAIL

Version 2.0 also provides integrated e-mail for electronic communication with your contacts. Supporting cc:Mail, Microsoft Mail, and CompuServe, ACT! sends and receives mail; attaches files, calendar activities, and contact records to messages; and lets you compose and read mail off-line.

Though you can broadcast a

message to multiple users on different systems, you can't schedule automatic polling of a CompuServe mailbox. Nor does ACT! alert you as new mail hits the inbox. Merging ACT! data attached to a message, however, is both simple and secure: You manually decide whether to overwrite an existing contact, for instance.

For all its prowess, however, ACT! 2.0 for Windows is a relatively rigid program. While most PIMs and many contact managers stress flexibility in storing and recalling random data, ACT! has a difficult time dealing with information that doesn't fit into its preset database.

Though you can launch other applications from within ACT!, it has no provision for associating files (word processing documents, for example) with its contacts. Also absent is a way to attach comments to an activity, such as an upcoming meeting. And while its notes serve as an adequate depository for contact-related data, ACT! can't readily absorb external information (you can insert only text and RTF-formatted files into a

note), nor can it instantly locate data buried within a note.

When structure is your ideal and you're more concerned with person-to-person dealings than with loose collections of information, ACT! 2.0's rigidity shouldn't be a problem. Its lower price (it was previously \$399) and new workgroup abilities make it an excellent contact management pick.

• List price: ACT! 2.0 for Windows, \$279.95; upgrade, \$69.95; 4-user network pack, \$799. Requires: 4MB RAM; 15MB hard disk space, Microsoft Windows 3.1. Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234, 408-253-9600.

Circle 421 on reader service card



From May 23 through May 27, you can go on-line to download an evaluation version of ACT! 2.0 for Windows or to discuss the program with Gregg Keizer and Symantec's Steve Singh and Greg Head. Type GO EXEC from any CompuServe prompt.

■ All-in-One Communications

\$349 DSP-Based Spectrum Envoy Needs a Software Boost

BY DAVID HASKIN

Multipurpose add-in boards based on digital signal processor (DSP) chips may be the wave of the future, but judging by the \$349 DSP-based Spectrum Envoy from Spectrum Signal Processing, the future hasn't arrived yet. While the Envoy is full of obvious potential, its accompanying software has some serious bugs and limitations.

Based on IBM's Mwave DSP technology, the Envoy can handle 14.4-bps data and 9,600-bps fax transmission, single-line telephone management, and 8-bit mono sound. Putting everything together lessens the number of communications devices and peripherals small offices must contend with.

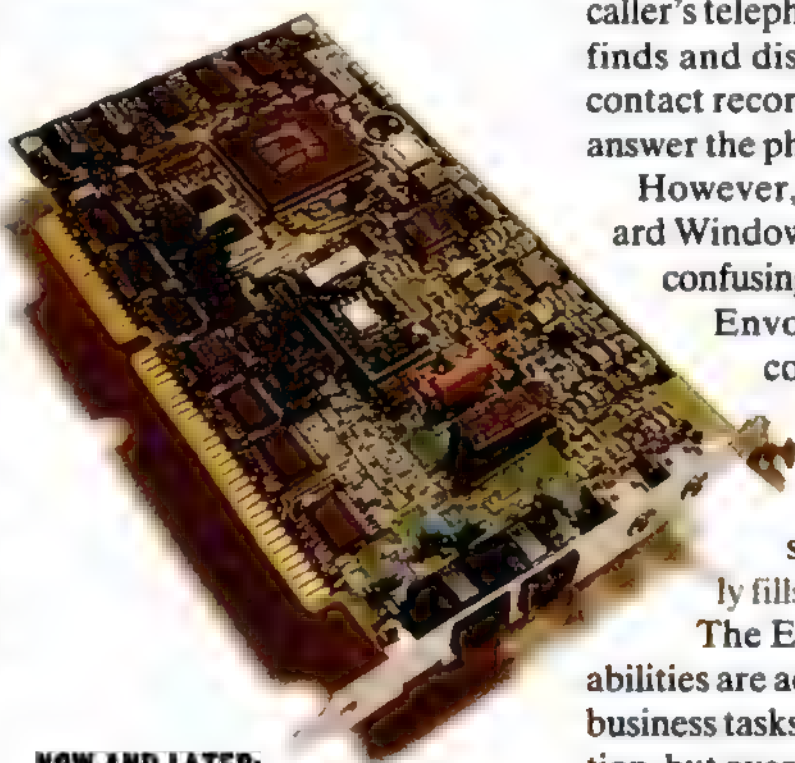
The DSP also acts as a co-processor, relieving your system's CPU from handling sound, communications, and telephone management chores. In testing, we were able to send and receive long faxes without interrupting the use of other applications—a benefit telephone- and fax-bound professionals will appreciate.

GET READY TO UPGRADE

Another important benefit of DSP-based boards like the Envoy is that they are software upgradable. For example, to operate as a data modem, the Envoy uses software that emulates the Hayes AT command set usually contained in a modem's ROM. As standards evolve, you need only to obtain the appropriate software upgrade to improve the Envoy's capabilities.

Unfortunately, you'll need to take advantage of the Envoy's software upgradability immedi-

ately because its current software is confusing, buggy, and underpowered. In testing, its problems started at installation time, when it detected an IRQ conflict but didn't suggest the conflict's source.



NOW AND LATER:

DSP technology makes the Envoy software upgradable.

After finding and resolving a conflict with an installed Pro Audio Spectrum 16 sound card, the installation program failed to detect a second IRQ conflict with the sound card's Sound Blaster emulation. Even after removing the sound card, Windows would not work reliably until we removed references to drivers the sound card had left in the SYSTEM.INI file.

A PERSONAL RECEPTIONIST

Once it is operating, the Envoy's strong suit is the single-line phone management capabilities provided by the bundled Personal Telecommunications Assistant (PTA) program from OCTuS. PTA lets you create a system of folders for

storing your calls, and it logs all inbound and outbound calls.

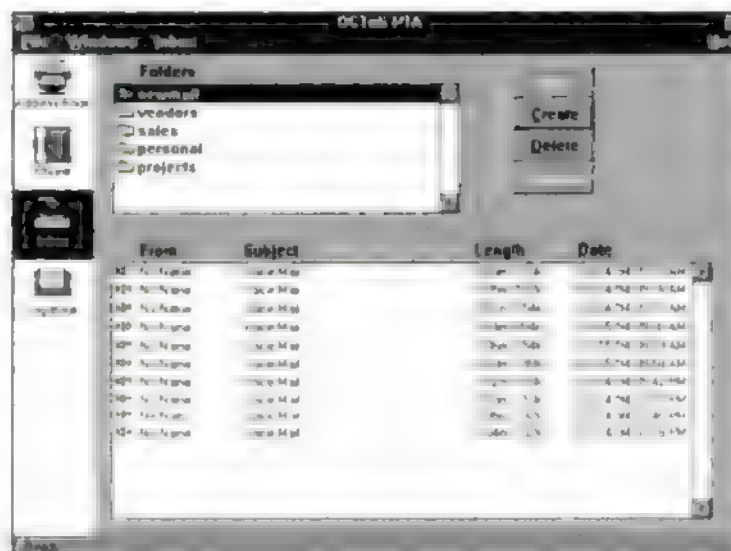
PTA also includes a reasonably competent contact manager and supports such capabilities as caller ID. After using caller ID to determine an incoming caller's telephone number, PTA finds and displays the caller's contact record even before you answer the phone.

However, PTA's nonstandard Windows interface is a bit confusing, and although the

Envoy has message-compression capabilities, PTA can't manage compressed files, so your disk quickly fills up with messages.

The Envoy's audio capabilities are adequate for simple business tasks like voice annotation, but overall sound quality is a bit muddy. More annoying is a lag time as long as 2 seconds before a sound initially plays—the result of the software and Mwave chip interaction.

Spectrum ties the Envoy's capabilities together with two util-



PHONE CONTROL: The voice-messaging program includes a contact manager.

ities: Aura Monitor and Discriminator. Discriminator automatically routes incoming fax and voice calls. Unlike similar products, however, Discrimi-

nator requires that the receiving software (such as PTA and QuickLink) be loaded before it will work. This decreases the Windows memory and resources available for other applications.

When Discriminator senses an incoming voice call, it displays a toolbar with buttons for picking up the phone, sending the call directly to voice mail, or playing a secondary recording asking the caller to hold. If you aren't present, Discriminator automatically starts the voice-mail process.

Before an application can use the Envoy, Aura Monitor must both load and register it in its database. Aura Monitor refuses to load more applications when DSP resources are low and, laudably, can automatically unload one application and start another. However, for some users Aura Monitor imposes a significant limitation: You can only use DOS programs with the Envoy in a DOS window. That's because Aura Monitor only comes as a Windows application, and the Envoy won't work without it.

Closing Aura Monitor by clicking on its minimized icon and selecting Close damages the application registration database, and you must re-register your applications. You can only successfully unload Aura Monitor when it is the active window.

The Envoy is certainly a good indicator of the potential of DSP-based multipurpose boards, but its software is holding it back. Spectrum says that an inexpensive software upgrade will arrive this summer. Let's hope it's worth the wait.

• List price: *Spectrum Envoy*, \$349. Requires: 2MB RAM, 10MB hard disk space, Microsoft Windows 3.1. *Spectrum Signal Processing Inc.*,

8525 Baxter Pl., 100 Production Ct., Burnaby, B.C., Canada V5A 4V7; 800-667-0018, 604-421-5422; fax, 604-421-1764.

Circle 420 on reader service card

Personal Finance

Reuter's Money Network: A Quicken Link for Instant Investment

BY CHRIS SHIPLEY

Reality Technologies' Reuters Money Network, formerly called Smart Investor, has always been an excellent tool to help you research and track investments. Now, this combination on-line service/financial-analysis tool has come out in a special version that will prove exceptionally useful to people who track investments using Intuit's Quicken.

The new \$24.95 version, Reuters Money Network Version for Quicken Users, has most of the market tracking features of the "standard" version. You can retrieve stock and fund quotes, check highlights of the day's financial news, and delve into databases detailing more than 18,000 investments.

In addition, the new Quicken-specific version seamlessly integrates data from the finance program's portfolio section. Once imported into Reuters Money Network, you can monitor and analyze that information to determine how your investments are performing.

Each time you open Reuters Money Network, the software updates your portfolio information from Quicken, if you so desire, and presents you with a personal "newspaper" that updates market news, alerts you to new information available on-line, and details the value of your portfolio.

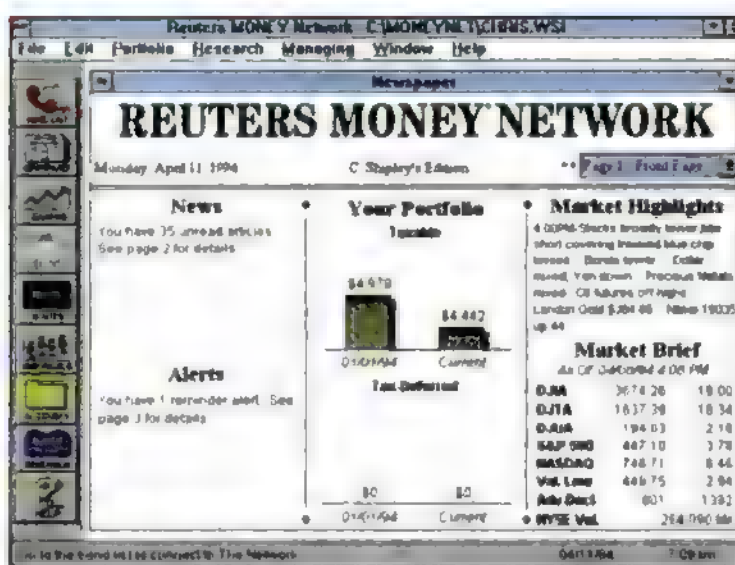
In addition to updates on the day's market indicators and volume, the service also offers a Personalized News Clipping Service. This service sends articles to your PC based on an investment profile you specify. The news service costs an additional \$6.95 per month for the first 1,000 articles.

About the only thing you can't do with Reuters Money Network is buy and sell securities on-line. Reality promises that this capability will be added soon; the upgrade will be provided free to registered users.

Reuters Money Network is a vital tool to anyone actively tracking investments with Quicken. With a street price of about \$10 and the first month's

on-line time free, it's well worth it for Quicken users to just give this product a tryout. You can't lose, and you may even find a few sleeper investments.

• List price: Reuters Money Net-



FRONT PAGE: Reuter's Money Network generates a personal "newspaper" for you.

Memory Utilities

Multimedia Cloaking Reclaims RAM Gobbled By Drivers

BY SHERYL CANTER

Do you use a mouse driver, disk cache, and CD-ROM extensions? Would you like to get back 50K of the conventional memory that those drivers eat up? Helix Software Co.'s Multimedia Cloaking (\$39.95) can deliver, using a technology called *cloaking*.

The traditional way to move TSRs and drivers out of conventional memory is to load the program data into upper memory blocks—the memory between 640K and 1MB. Upper (or extended) memory fills quickly; but even when it's available, program code must be loaded low, in the precious and limited region below 640K.

Cloaked programs—code and data—can be loaded almost entirely into extended memory, the plentiful memory above 1MB. Cloaked programs actually run more quickly than their real-mode counterparts because they are 32-bit and run in protected mode.

Not just any program can be loaded into extended memory; it must be built especially for this purpose. (See the review of Helix's Cloaking Developer's Toolkit in *PC Magazine's* Toolkits column, May 17, 1994.) Multimedia Cloaking includes cloaked replacements for the mouse driver, disk cache, and CD-ROM extensions.

The replacement mouse driver is Version 6.33 of the Logitech driver, cloaked by Helix. It works with all Logitech, Microsoft, and compatible mice. The disk cache supports hard disks, floppy disks, and CD-ROMs.

Two versions of the CD-ROM extensions come with the software. One is a cloaked version of the MSCDEX.EXE utility that ships with MS-DOS 6.2. The other is a clone written by Helix. Because of Microsoft licensing requirements, you must already have the original MSCDEX.EXE on your system to use the cloaked version. The Multimedia Cloaking Setup program checks your hard disk

work Version for Quicken Users, \$24.95. On-line fees: \$9.95 per month for quotes; monthly mutual fund, money market, and CD database updates; investment alerts; and market briefs. \$17.95 per month for basic services, plus monthly update to stock and bond databases; and historical pricing charts. Requires: 4MB RAM, 8MB hard disk space, Microsoft Windows 3.1, modem; Quicken 2.0 or 3.0 for Windows required for investment tracking. Reality Technologies Inc., 2200 Renaissance Blvd., King of Prussia, PA 19406; 800-346-2024, 215-277-7600; fax, 215-278-6115. Circle 431 on reader service card

for MSCDEX.EXE and determines whether to install the Microsoft driver or Helix's clone driver.

To use these cloaked "client" utilities, you must have a cloaking "host" installed on your system. If you use NetRoom, Helix's memory manager, then you already have one. If you use some other memory manager, the Setup program will add a cloaking host that works with your memory manager.

If you use a mouse driver, disk cache, or CD-ROM exten-

Memory Magic

On our test system, Multimedia Cloaking reclaimed almost 50K of conventional memory.

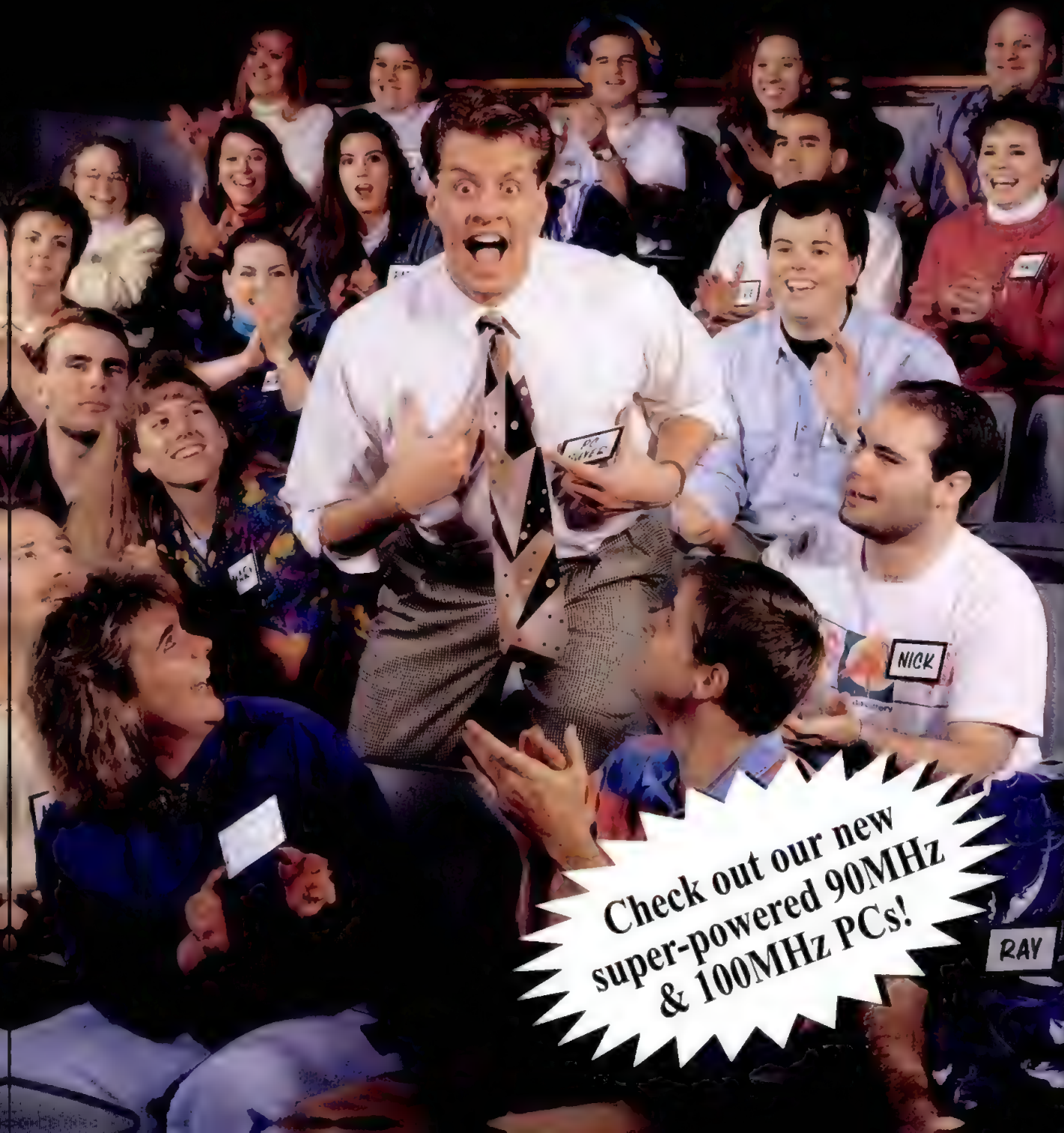
Conventional Memory Used		
	Uncloaked	Cloaked
Mouse driver	16.5K	0.8K
Disk cache	26.8K	5.8K
CD-ROM extensions	15.3K	2.5K
Total	58.6K	9.1K

sions, Multimedia Cloaking will give you back a significant chunk of that precious conventional memory.

• List price: *Multimedia Cloaking*, \$39.95. Requires: 1MB RAM, DOS 3.3 or later. Helix Software Co., 47-09 30th St., Long Island City, NY 11101; 800-451-0551, 718-392-3100; fax, 718-392-4212.

Circle 425 on reader service card

PC Buyer C'mon Down!



Check out our new
super-powered 90MHz
& 100MHz PCs!

RAY

Get A Fortune Of Value

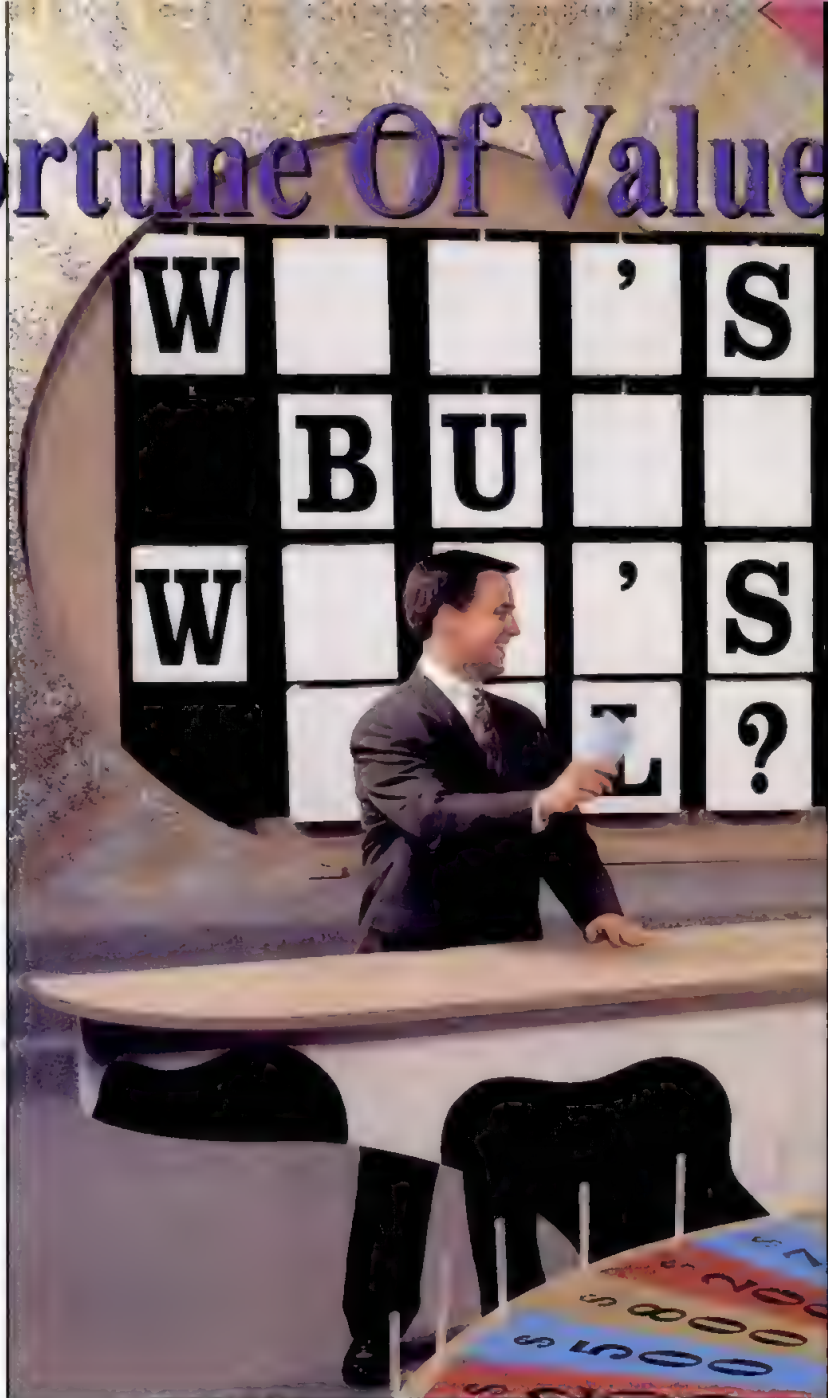
PC Buyers jump for joy! You're entering the exciting and competitive game of computer buying! We know you want to finish first with high-performance PCs and prize-winning service at the most affordable prices in the industry. It's no contest — with Gateway 2000™ you'll always be the winner!

And here are the stars of our show, Gateway's Pentium™-based systems! You'll get a shining performance with our new incredible **90MHz** P5 system! And the stupendous performance of new lightening-fast hard drive systems! Screaming graphics controllers on the top two P5 models! Along with the most powerful Intel® processors available today! And (*drumroll please*) — all at 486 prices!

Intel's new **90MHz** processor gives our top-of-the-line, power-packed Pentium-based system the edge — it's one of the fastest PCs available today. And now in all Gateway 2000 P5 and 486 PCI systems, a new PCI/IDE controller allows the hard drive to transfer data up to twice as fast as non-PCI-based systems. The PCI/IDE controller enhances our Intel Pentium processor and PCI local bus for faster-than-ever data access!

Take full advantage of the performance-boosting PCI bus with high-end graphics controllers with 2MB VRAM on our top two P5 systems, for virtually unbeatable graphics! All other Gateway Pentium and 486 PCI-based systems come with a standard graphics with 1MB or 2MB graphics memory giving you up to 64,000 colors at 1024 x 768 resolutions.

Been spinning your wheels on how to get tomorrow's technology today and still pay 486 prices? With prices between \$2,495 and \$3,995, the puzzle is solved when you buy a Pentium-based system from Gateway 2000!



The Bonus Round

Win big with a 486 PCI system that blows the competition away! You'll get the pinnacle of 486 performance with Gateway's new **100MHz** DX4 machine priced at \$2,495. The Gateway P4D-100 includes 8MB RAM, a 540MB hard drive, double-speed CD-ROM, 15-inch color CrystalScan® monitor, 128KB cache, 1MB PCI local bus graphics and your choice of application software. And you can upgrade all of our 486 systems to Pentium technology in the future. It's another sure winner from Gateway 2000!

With Gateway 2000!



The Home Version

Fun and games are only part of what you get with the Gateway DX2-66 Family PC,[™] our best-selling Family PC model priced at only \$1,995! All Family PC configurations include full multimedia capabilities and software choices for the whole family, bringing productivity, education *and* entertainment into your home.



8 0 0 - 8 4 6 - 2 0 6 3

"X" Marks The Spot

Looking for the perfect portable PC? You'll get a celebrity performance when you choose Gateway 2000™ for the most value-packed portable PCs in the industry!



Gateway has all the right answers for incredible values with the ColorBook! Performance-enhancing features ... fast 486 processors and an incredibly big 10.3-inch screen on two ColorBooks models! ... make the ColorBook an undisputed champion.

Introducing the **ColorBook DX4-75** with a faster-than-ever processor! The substantial power boost of the 75MHz processor has made this model the fastest 486 portable available today. And that's not all. For your extreme viewing pleasure, an extra-huge 10.3-inch dual-scan VGA color screen is standard on the DX2-50 and DX4-75 models. You won't find anyone else with a 10.3-inch screen at a better price.

All ColorBook models — 4SX-33, DX2-40, DX2-50 and DX4-75 — have a host of great features. At less than 5.7 pounds and measuring an ultra-thin 1.77 inches, the ColorBook supports simultaneous video; has an easy-to-use, built-in trackball; two PCMCIA Type II slots; great battery life; and a suspend/resume feature so you can stop work anytime and resume later without losing data or restarting the system.

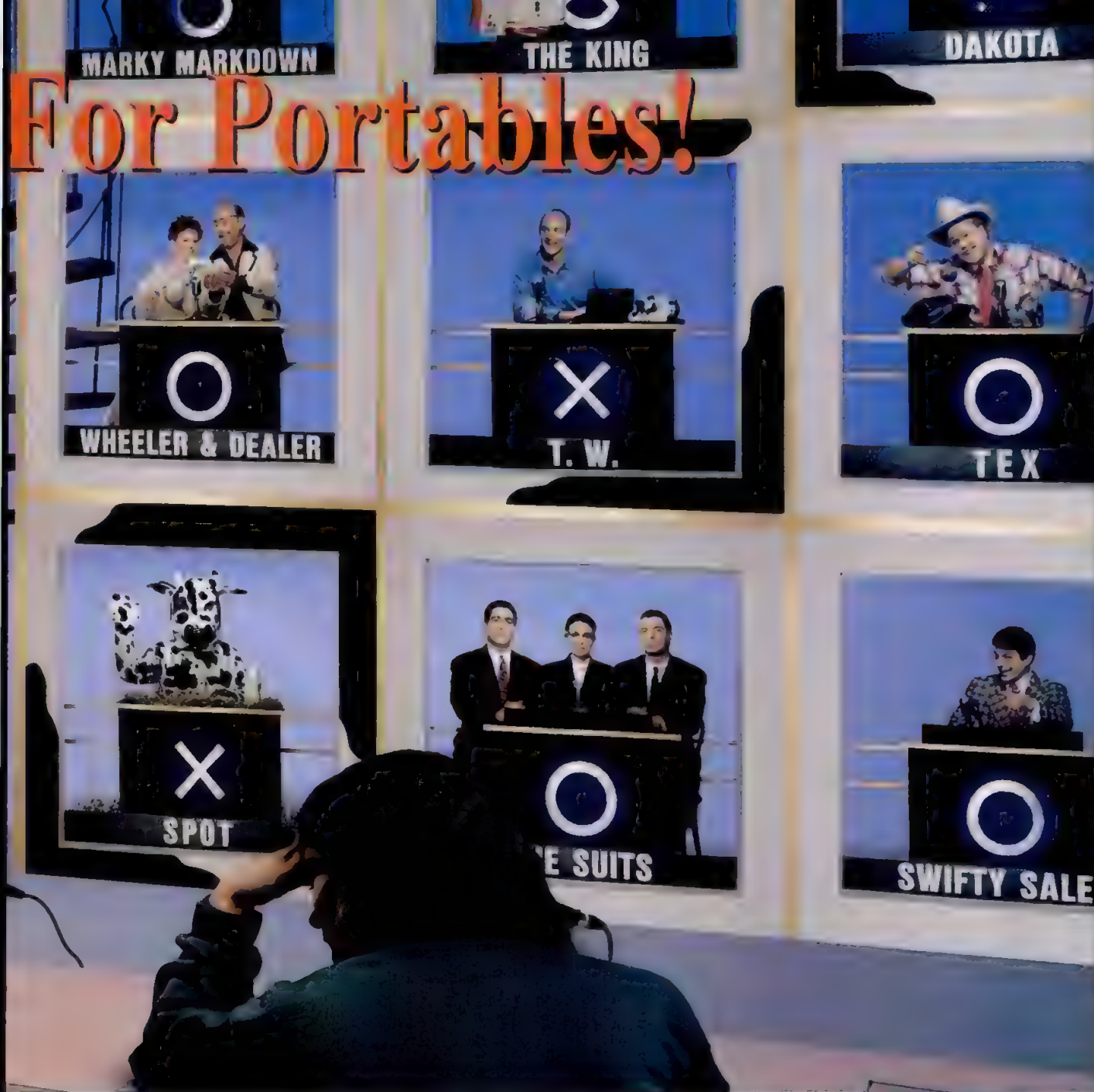
GATEWAY2000 HANDBOOK® 486

The revolutionary Gateway HandBook 486 is perfect for all your worldly travels. This powerful little performer will forever change the way you use a PC. And you won't have to think twice about taking it with you — no matter where you



go. It's a no-brainer. The HandBook is so small (*about the size of a day planner*) and so lightweight (*it's less than three pounds*) that you'll never want to be without it!

Unless you mind all the extra attention, as described by a leading columnist: "I almost got mobbed the other day on the train. I was doing what I usually do on the commute: writing on a notebook computer. The only difference was that I was using a Gateway 2000 HandBook 486 ... I can't wait until everyone has one. Then they'll leave mine alone."



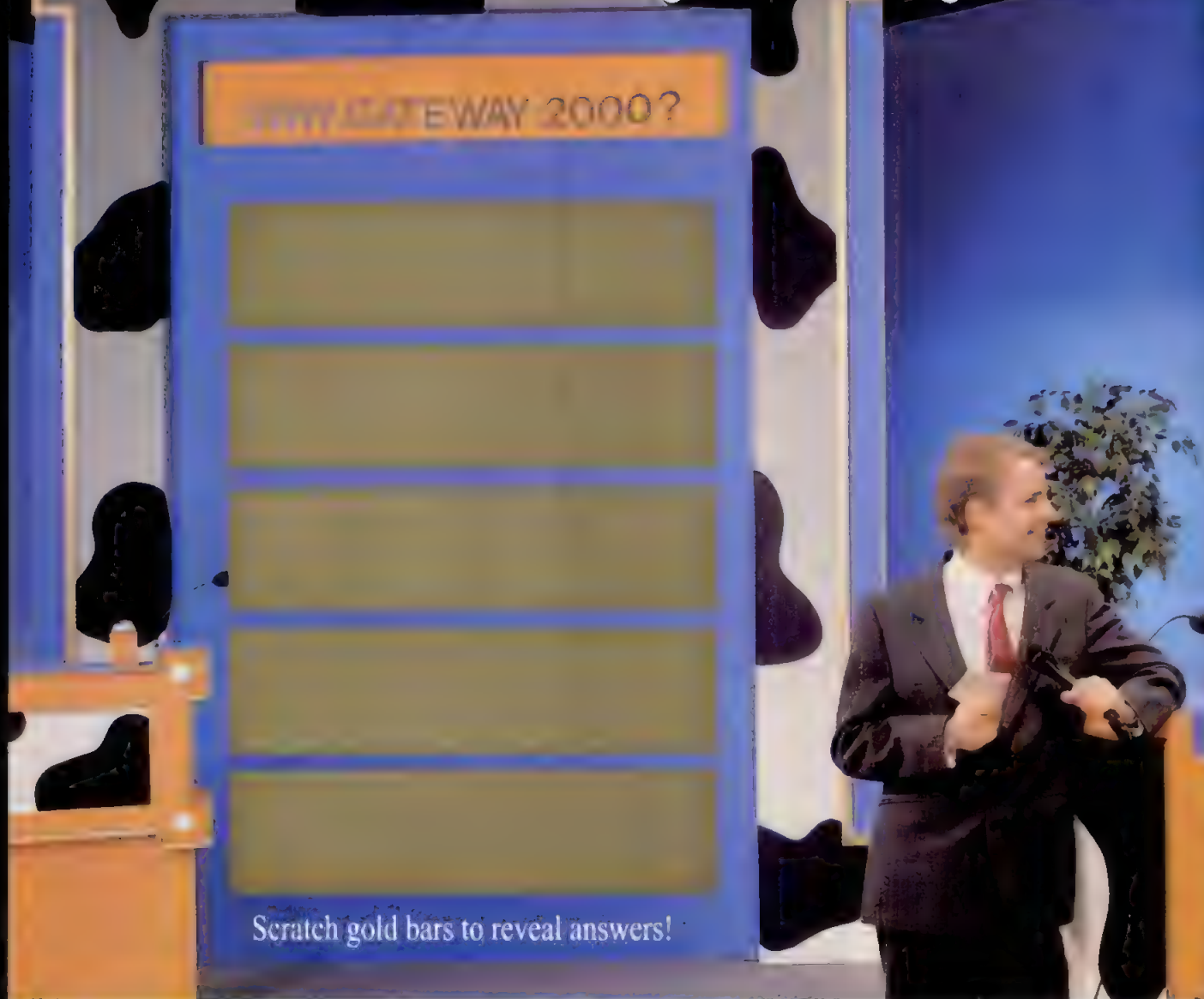
The HandBook is a real PC with a powerful 486 processor; an IDE hard drive up to 130MB; standard 4MB or 8MB RAM upgradable to 20MB; a 7.9-inch bright, backlit VGA display screen; 78-key keyboard; EZ Point™ integrated pointer; excellent battery life; and suspend/resume feature.

Looking for a square deal on the best portables around? The odds are stacked in your favor with Gateway's ColorBook and HandBook portable PCs.



8 0 0 - 8 4 6 - 2 0 6 3

The Surveys Say...



Scratch gold bars to reveal answers!

Gateway 2000™ is the name of the game when it comes to the best service and support. The Gateway family is made up of hard-working Midwesterners who are dedicated to satisfying our customers. And although we're a Fortune 500 company, we haven't forgotten our simple philosophy of providing an honest value, a superior product and the best service possible. In return, Gateway's loyal customers are always there to cheer us on. But you don't have to just take our word for it. The surveys prove it!

Hands Down Winner in Service and Reliability

A big thank you to readers of *PC Magazine* who responded to a Service and Reliability survey with impressive results: "In our latest survey, only Gateway 2000 gets our highest rating in both the desktop and laptop categories." The survey covered reliability, satisfaction with repair experience, satisfaction with technical support, and the likelihood of buying new PCs from the same vendor again.



All the talented people appearing in this ad are Gateway 2000 employees

PORTABLES

HANDBOOK® 486

- Weight: 2.94 Lbs.
- Dimensions: 9.75" x 5.9" x 1.6"
- SL Enhanced Intel® 486 or DX2 Processor
- 4MB or 8MB RAM (expands to 20MB)
- 80 to 130MB IDE Hard Drive
- 7.9" Backlit VGA Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 1 PCMCIA Type II Slot
- EZ Point™ Integrated Pointer
- 78-Key Keyboard
- Parallel, Serial & PS/2® Ports
- MS Works for Windows™ 3.0
- MS-DOS 6.2, WFW 3.11 & Serial Transfer Cable

HANDBOOK 4SX-25

With 25MHz 486SX CPU, 4MB RAM and 80MB Hard Drive
\$1495

(with 130MB Hard Drive)
\$1595

HANDBOOK 4DX2-40
With 40MHz 486DX2 CPU, 8MB RAM, 130MB Hard Drive, Extra NiMH Battery and Leather Carrying Case
\$2295

HANDBOOK 4SX-25
With 25MHz 486SX CPU, 8MB RAM, 130MB Hard Drive and Leather Carrying Case
\$1895

PORTABLE OPTIONS

PCMCIA Cards:

- TelePath™ 14400/14400 fax/modem. **\$249**
- 9600/2400 fax/modem. **\$149**
- Ethernet adapter. **\$149**
- Token Ring adapter. **\$449**
- HandBook VGA adapter. **\$229**

Batteries:

- 2.2Ah NiMH batteries. **\$89**
- Alkaline battery pack. **\$29**

Diskette Drive:

- HandBook external 1.44MB. **\$99**

Cases:

- ColorBook **\$49**, HandBook **\$55**

Extended VIP Warranty:

- We'll ship a replacement within 24 hours during warranty. Point of sale only. **\$100**

COLORBOOK™

- Weight: Under 5.7 Lbs.
- Dimensions: 11.7" x 8.5" x 1.77"
- SL Enhanced Intel 486, DX2 or DX4 Processors
- 4MB or 8MB RAM (expands to 8, 12 or 20MB)
- 3.5" 1.44MB Diskette Drive
- Removable 120 to 250MB IDE Drive
- 10.3" or 9.4" VGA Dual-Scan STN Color Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 2 PCMCIA Type II Slots
- Integrated Trackball (2 buttons)
- 85-Key Keyboard
- Parallel, Serial & PS/2 Ports
- External VGA Port
- MS Works for Windows 3.0
- MS-DOS 6.2 & WFW 3.11

COLORBOOK DX4-75

With 75MHz DX4 CPU, 8MB RAM, 250MB Hard Drive and 10.3" LCD
\$3495

COLORBOOK 4SX-33

With 33MHz 486SX CPU, 4MB RAM, 120MB Hard Drive and 9.4" LCD
\$1995

COLORBOOK DX2-40

With 40MHz DX2 CPU, 4MB RAM 250MB Hard Drive and 9.4" LCD
\$2495

COLORBOOK DX2-50

With 50MHz DX2 CPU, 8MB RAM 250MB Hard Drive and 10.3" LCD
\$2995

COLORBOOK PACKS

Traveler's Packs:

- Case, extra battery & PCMCIA 9600/2400 fax/modem. **\$279**
- Case, extra battery & PCMCIA TelePath fax/modem. **\$369**

PC
BUYER

SOFTWARE & EXTRAS

If a system comes with "choice of application software," choose one of the following packages:

- Microsoft Excel for Windows™
- Microsoft Word for Windows™
- Microsoft Word and Bookshelf® CD-ROM Edition
- Microsoft PowerPoint for Windows™
- Microsoft Project for Windows™
- Microsoft Access™ for Windows
- Publisher's Pack (CD-ROM only; includes CorelDRAW 3,™ ArtShow, MS Publisher 2.0 & MS Design Pack)

- The Entrepreneur Pack (Works,™ Publisher,™ Money™ & games)
 - Borland Paradox® and Quattro® Pro for Windows spreadsheet
 - Borland Paradox® and C++ (CD-ROM only)
- With desktop and selected portables you also get the following software and extras at no additional charge:
- MS-DOS 6.2 & Windows for Workgroups 3.11
 - CoSession™ Host Remote Diagnostics (with all modems)

- QAPLUS Diagnostics
 - Gateway Computer Glossary
 - Gateway Mouse Pad
- Systems with CDs also include:
- Gateway System CD
 - On-Line User's Guide
 - Gateway Mail On-Line Catalog

Every Gateway system is backed by:

- 30-Day Money-Back Guarantee
- One-Year Limited Warranty
- Lifetime Toll-Free Technical Support
- On-Site Service Available To Most Locations
- Lifetime BBS Membership
- FaxBack Automated Fax Service

Our money-back guarantee does not include shipping. On-site service is provided at no charge during warranty if our technicians determine it is necessary. If you'd like to read our warranty and guarantee policies, please call for a free copy.



Printed on recycled paper with soy inks.

Gateway 2000 is a corporate sponsor of
GLOBAL WARMING



Ready For Action

Gateway 2000's friendly employees will take care of you from your first phone call throughout the life of your system with lifetime technical support. We've also made it easy for you to buy one of our world-famous PCs.



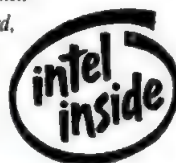
transactions, you get a variable interest rate of 13.9% APR and a low \$18 annual fee.*

**Cash advance fee is \$1 plus 2% of the amount of the cash advance, but not less than \$5 nor more than \$10. Financing is available on approved credit with the Gateway DuoLine MasterCard, issued by Dial National Bank, Des Moines, Iowa.*

Internationally Known

Gateway 2000 also makes it easy for our neighbors in Canada and Puerto Rico to buy Gateway systems. You get award-winning technical support, CSA approvals, and on-site service that is available in most Canadian and Puerto Rican locations. Our international shipping rates are some of the most competitive in the industry. Canadian and Puerto Rican customers can reach us toll free at 800-846-3609. All other international customers can call us at 605-232-2000.

Our Family PC comes with a 14-inch color SVGA monitor, 101-key keyboard, double-speed CD-ROM, sound card, speakers, joystick, fax/modem and multimedia software. You choose one software option from five great Family PC multi-title packages.



Easy Payment Options

Gateway accepts most major credit cards and C.O.D. terms, with net 30-day terms and leasing options available to qualified commercial customers.

You can also apply for our new Gateway 2000 DuoLine MasterCard® Card, issued by Dial National Bank, which lets you make purchases from Gateway and anywhere else MasterCard is accepted by giving you two lines of credit — one for Gateway purchases and one for all other purchases. For Gateway purchases, the card has no annual fee and a low variable interest rate of just 12.9% APR. For other



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Inverted Foldout slip-sheet

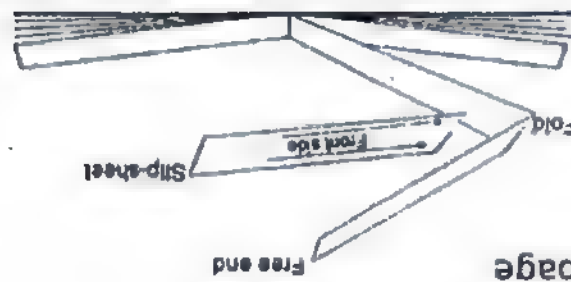
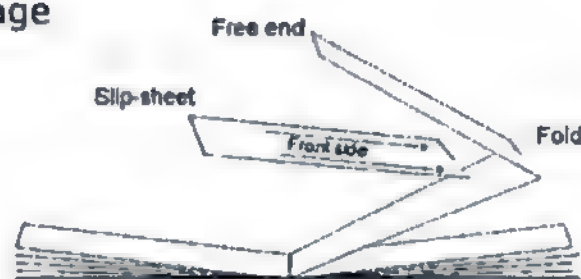


GbsSlipSheet-001

Folded edge of the page

Foldout slip-sheet

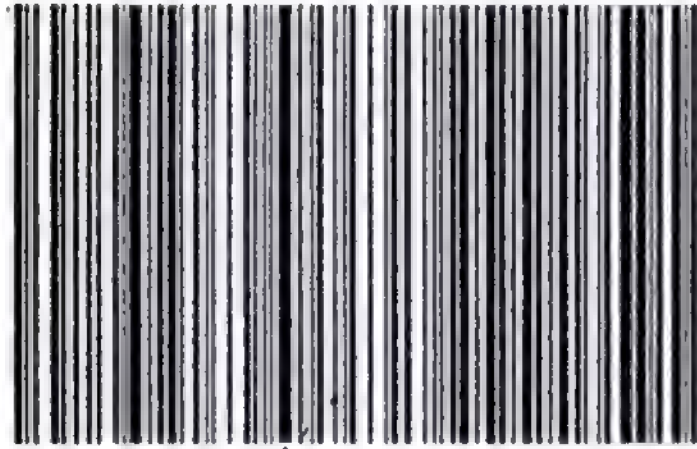
1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

1. Follow instructions on the other side

Inverted Back



GbsSlpBack-001B

Back

1. Follow instructions on the other side



World Class Winning

PC World's 1993 World Class Awards found readers honoring Gateway 2000 with top honors in five categories including Best Service and Support (for the second year in a row!) and Best Mail Order Company. Thank you, *PC World* readers!

Jesse Berst, editor of *Windows Watcher* was quoted in *PC World*: "Gateway has discovered an amazing secret, give people more for less and they are going to like you." We knew our secret wouldn't be safe for long!



Good Answers!

Computer Shopper summarized its readers' responses best: "Gateway, dominator of Best Buy balloting for the past three years, is your choice as Best Overall Supplier of computer systems ... For state-of-the-art PCs at bargain prices, North Sioux City is where *Shopper* readers look first." And "...Gateway 2000 has inspired a high degree of confidence and brand loyalty among *Shopper's* readers, who continue to rank Gateway's service and support as the best of all direct-channel PC vendors." Thanks *Shopper* readers!



INTEGRATED SYSTEMS

4SX-33/4DX-33

- Intel® 33MHz 486SX or DX CPU
- 4MB RAM
- 340MB 13ms IDE Hard Drive
- Local Bus Graphics with 1MB
- 3.5" Diskette Drive
- 14" Color CrystalScan® 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 101-Key Keyboard & MS Mouse
- MS-DOS® 6.2 & WFW™ 3.11
- MS Works for Windows™ 3.0
- EPA Energy Star Compliant

4SX-33 \$1295

4DX-33 \$1495

4SX-33 FAMILY PC

- Intel 33MHz 486SX CPU
- 4MB RAM
- 340MB 13ms IDE Hard Drive
- Local Bus Graphics with 1MB
- Double-Speed CD-ROM, 16-Bit Sound Card & Speakers
- 2400/9600 Data/Fax Modem
- 3.5" Diskette Drive
- 14" Color SVGA Monitor
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 101-Key Keyboard, MS Mouse & Joystick
- MS-DOS 6.2 & WFW 3.11
- Choice of Family PC Software
- EPA Energy Star Compliant

\$1495

4DX2-66 FAMILY PC

- Intel 66MHz 486DX2 CPU
- 8MB RAM, 128KB Cache
- 340MB 13ms IDE Hard Drive
- Local Bus Graphics with 1MB
- Double-Speed CD-ROM, 16-Bit Sound Card & Speakers
- 2400/9600 Data/Fax Modem
- 3.5" Diskette Drive
- 14" Color SVGA Monitor
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 101-Key Keyboard, MS Mouse & Joystick
- MS-DOS 6.2 & WFW 3.11
- Choice of Family PC Software
- EPA Energy Star Compliant

\$1995

MULTIMEDIA KIT

Here's everything you need to add multimedia to a Gateway desktop PC that has a CD-ROM drive. You won't find a better price anywhere!

- Gateway 2000 16-Bit Sound Card, Sound Blaster™ Compatible
- 2 Labtec® CS-180 Speakers
- Microsoft Encarta & Corel Photos CD Software

\$132 (with system purchase)

Get the multimedia kit with a CD-ROM drive for **\$299** (with system purchase).

486 PCI SYSTEMS

P4D-33

- Intel 33MHz 486DX CPU
- 8MB RAM, 128KB Cache
- 540MB 13ms IDE Hard Drive
- PCI Fast IDE Interface
- PCI Local Bus Graphics with 1MB
- Double-Speed CD-ROM
- 3.5" Diskette Drive
- 14" Color CrystalScan 1024NI
- Baby AT Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- AnyKey® Keyboard & MS Mouse
- MS-DOS 6.2 & WFW 3.11
- MS Works Multimedia Edition 3.0

\$1995

P4D-66

- Intel 66MHz 486DX2 CPU
- 8MB RAM, 128KB Cache
- 540MB 13ms IDE Hard Drive
- PCI Fast IDE Interface
- PCI Local Bus Graphics with 1MB
- Double-Speed CD-ROM
- 3.5" Diskette Drive
- 15" Color CrystalScan Monitor
- Baby AT Case
- 5 ISA & 2 VESA/ISA Slots
- AnyKey Keyboard & MS Mouse
- MS-DOS 6.2 & WFW 3.11
- Choice of Application Software

\$2295

P4D-100

- Intel 100MHz 486DX4 CPU
- 8MB RAM, 128KB Cache
- 540MB 13ms IDE Hard Drive
- PCI Fast IDE Interface
- PCI Local Bus Graphics with 1MB
- Double-Speed CD-ROM
- 3.5" Diskette Drive
- 15" Color CrystalScan Monitor
- Baby AT Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- AnyKey Keyboard & MS Mouse
- MS-DOS 6.2 & WFW 3.11
- Choice of Application Software

\$2495

PENTIUM SYSTEMS

P5-60

- Intel 60MHz Pentium™ CPU
- 8MB RAM, 256KB Cache
- 340MB 13ms IDE Hard Drive
- PCI Fast IDE Interface
- PCI Local Bus Graphics with 1MB
- Double-Speed CD-ROM
- 3.5" Diskette Drive
- 15" Color CrystalScan Monitor
- Baby AT Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- AnyKey Keyboard & MS Mouse
- MS-DOS 6.2 & WFW 3.11
- MS Works Multimedia Edition 3.0

\$2495

P5-66

- Intel 66MHz Pentium CPU
- 8MB RAM, 256KB Cache
- 540MB 13ms IDE Hard Drive
- PCI Fast IDE Interface
- PCI Local Bus Graphics with 2MB
- Double-Speed CD-ROM
- 3.5" Diskette Drive
- 15" Color CrystalScan Monitor
- Baby AT Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- AnyKey Keyboard & MS Mouse
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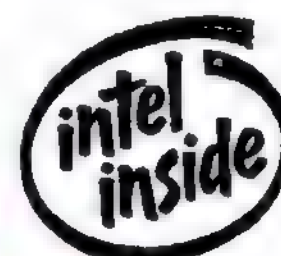
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Scanners

ScanMan PowerPage: Logitech's \$799 All-in-One Scanning Plan

BY BARRY SIMON

Logitech calls its \$799 ScanMan PowerPage "eyes for your computer." That basic concept is fine, even though the scanner's speed and design limitations leave its vision a little blurry.

The ScanMan PowerPage combines a Nisca 400-dot-per-inch, 256-gray-scale full-page scanner with some nifty Windows software. The scanner itself is page-oriented, but it's not a flatbed design. Rather, it's a wandlike box measuring 2.75 by 12 by 2.5 inches (HWD) through which pages feed on rollers. Aligning the pages to go through it straight can be tricky.

The scanner connects to your PC's parallel port, so setup is easy. Watch out, though. The parallel cable doesn't have a pass-through, so if you don't have two parallel ports, you'll have to do without a printer.

If you keep the scanner's control-center program running all the time, it pops up as soon as you insert a page in the scanner's slot. From there, you can perform four functions: image capture, OCR, copy, and fax.

Image capturing sends the image to the included image-editing software, Logitech FotoTouch. FotoTouch has the tools that are most important for scanning: adjustment of brightness and contrast, sharpening and smoothing filters, deskewing, and the ability to rotate an image by 90 or 180 degrees.

The optical character recognition component is a module from Caere Corp. that uses that firm's AnyFont technology. If you invoke the control center over your word processor, the text you scan in gets fed directly into your document. The software doesn't have the special

spell-checking that high-end OCR packages have to look for typical OCR errors (like mistaking the letters *cl* for *d*).

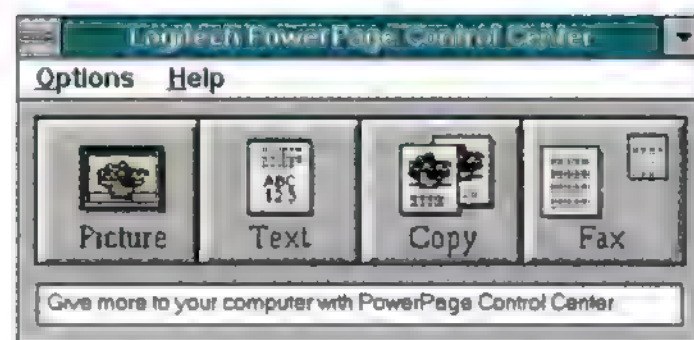
The fax module will link to



NEW SCANMAN: A compact design.

any Windows fax driver, including WinFAX Lite, which ships with the scanner. The copy module is one of those great ideas that makes you wonder why all scanners don't have one. You feed a document into the scanner and a copy comes right out of your printer.

The scanner's speed is slow at high resolution: about 2.5 minutes for a full-page scan at 400 dpi. If you can live with that slowness, you'll find ScanMan PowerPage a convenient, fairly priced,



ONE BUTTON AWAY: PowerPage's Control Center gives you access to four functions.

all-purpose scanning solution.

•List price: *ScanMan PowerPage, Version 1.0*, \$799. Requires: 4MB RAM, 6MB hard disk space, Microsoft Windows 3.1. Logitech Inc., 6505 Kaiser Dr., Fremont, CA 94555; 800-231-7717, 510-795-8500; fax, 510-792-8901.

Circle 401 on reader service card

Illustration

Visio Express Blends Seamlessly into Microsoft Office Suite

BY KATHLEEN CASTER

Visio, Shapeware Corp.'s successful drawing package, now has a \$79 sibling that integrates seamlessly with Microsoft Office thanks to OLE 2.0 automation and an almost identical interface.

Installing Visio Express for Microsoft Office adds an "Insert Visio drawing" icon to the toolbars in each application in the Standard Edition of Microsoft Office—Excel, PowerPoint, and Word for Windows. You enter Visio Express—a subset of Visio—from within Microsoft Office; from there you can work in place or in a full Visio Express screen. (Visio Express lacks Visio's multiple-page drawings and programmable shapes, and it has fewer drawing types.)

When you work on a Visio Express drawing, the toolbar and menu items in the Microsoft Office application change to include a range of Visio Express options, such as rotation and drawing icons. The

Visio Express toolbars and menus are similar to those in Microsoft Office, even when you're editing in the full Visio Express screen. Thanks to OLE 2.0, you can edit an Excel worksheet within a Word document and add Visio Express objects to both of those elements. You can have a report that includes a worksheet as well as a Visio Express drawing.

Visio Express helps you

management diagrams, and practice drawings.

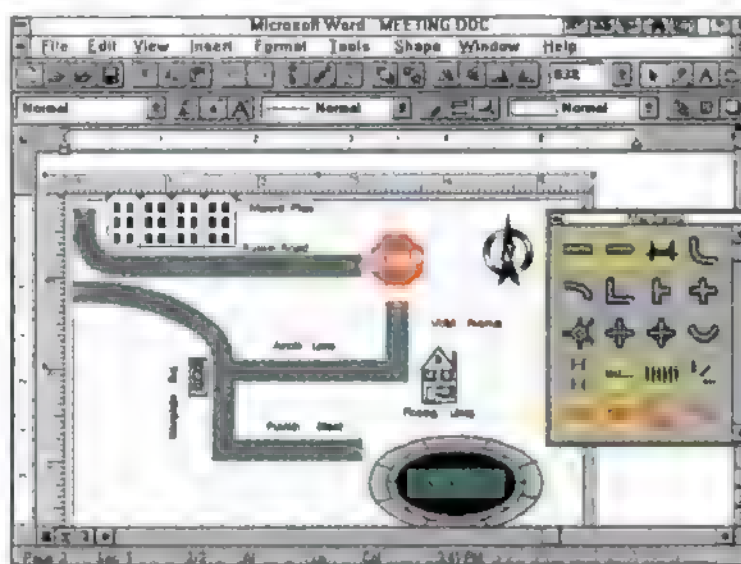
You might want to add a flowchart to a PowerPoint presentation, create a time line in an Excel worksheet, or build a diagram of a crisis-response plan in an employee handbook written in Word. Click outside of the drawing and you're back in the document, worksheet, or presentation. The Visio Express object is fully embedded and ready for edits at any time.

Creating a compound document is simple with Visio Express for Microsoft Office. Just the same, you're best off with a fast system and ample RAM; Shapeware recommends 6MB. Once you're properly outfitted, you may never leave your document again.

•List price: *Visio Express for Microsoft Office*, \$79. Requires: 6MB RAM,

Microsoft Office 4.0 (or any Office app), Microsoft Windows 3.1. Shapeware Corp., 520 Pike St., #1800, Seattle, WA 98101; 206-521-4500; fax, 206-521-4501.

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¹ Usability Science Corporation, dBASE IV v2.0 vs. FoxPro v2.5, June 1993. ² dBASE IV for UNIX sold separately. ³ dBASE Compiler for DOS sold separately. ⁴ See special offer in dBASE Compiler box or call Intel at 1-800-538-3373, ext. 249 for a free demo diskette. Prices good in the United States and Canada only. All prices are in U.S. dollars. Dealer prices may vary. Copyright © 1993 Borland International, Inc. All rights reserved. All product names are trademarks of their respective companies. BI 6429.1

Security

Norton DiskLock 3.0: Multilevel Protection From Prying Eyes

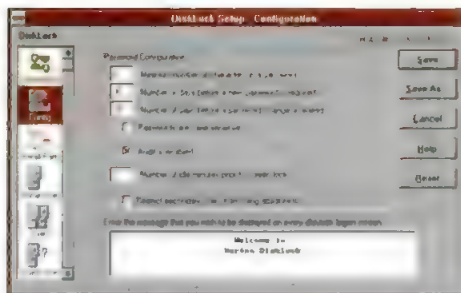
BY BRUCE SCHNEIER

With three levels of security protection, support for multiple users on the same machine, and a network version for centralized administration, Symantec's Norton DiskLock 3.0 (\$129) tries to satisfy many security requirements. While not up to military standards, DiskLock 3.0 is sufficient for most personal and corporate needs.

DiskLock's password protection guards your entire PC. One password belongs to you as the primary user; you have free run of the machine once you enter the correct password. You can also establish up to five secondary users who can access only certain files, and guest users, who have even more restrictions.

File locking prevents secondary users from accessing

privileged files. If a secondary user has authorization, he or she can view, modify, and copy a locked file. If not, he or she can't even see the file's name in the directory listings. The primary user can also encrypt files.



SECURITY: The Norton DiskLock makes it easy to feel secure.

DiskLock collects auditing data on user activities: who was logged on and when, what applications they used, when there were failed log-on attempts, and

any changes in DiskLock's configuration. The primary user can view, save, or print the file.

So far, so good, but all the security features aren't worth anything if they aren't secure. The password protection will

frustrate all but the most savvy hackers, and probably some of them as well. File locking is a nice feature, but it doesn't add to the difficulty of breaking DiskLock. If you are a home or business user with no well-funded enemies,

this is more than enough security for you.

If you need more security, encryption is your only hope. DiskLock's proprietary encryp-

tion algorithm is fast but insecure. The DES encryption algorithm is secure—do not choose the default password option—against all but major government military agencies.

One conspicuous absence is secure file erasure. DiskLock doesn't make sure to erase deleted files completely. An adversary with Norton Unerase can possibly recover your secrets. Remember, this assumes that the adversary can get around DiskLock's password protection; the vast majority of users won't have to worry about it.

- List price: *The Norton DiskLock 3.0*, \$129. Requires: 640K RAM, 2.5MB hard disk space, DOS 3.3 or later. Supports Windows 3.1.

- List price: *The Norton DiskLock Administrator 3.0*, \$1,161. Requires: 2MB RAM, 5MB hard disk space, DOS 3.3 or later (Windows module also available). Symantec Corp., 10201 Torre Ave., Cupertino, Calif., 95014; 800-441-7234, 408-253-9600; fax, 408-252-4694.

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PC Upgrades

Cyrix Chip Gives New 486 Life to Old 386 Systems

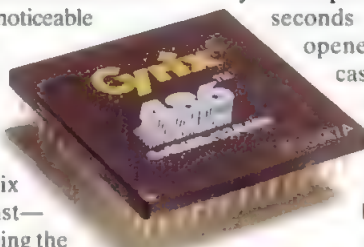
BY WINN L. ROSCH

Cyrix's Cx486DRx2 series of upgrade microprocessors offers quick, easy brain transplants for laggardly 386DX systems. Thanks to the recent addition of a clock-doubling 33/66-MHz version to last year's slower (16/32-, 20/40-, and 25/50-MHz) models (First Looks, October 12, 1993), you can now triple the performance of your 33-MHz 386-based PC—at least on some tasks—with a \$399 investment and a few minutes' work.

Although compatible with Intel's 486s (the Cyrix chips support the complete 486 instruction set), the Cx486DRx2 lacks an integral math coprocessor and uses only a 1K combined instruc-

tion-and-data cache. To make up for it, Cyrix incorporates a hardware multiplier that accelerates many integer operations.

The cache and clock-doubling result in a noticeable performance improvement. Individual tests show the internal logic of the Cyrix chip to be fast—more than tripling the speed of the basic 386DX on small-model problems, string sorts, and a prime number sieve. In fact, the upgraded system outperformed a true 33-MHz 486 on these tests. Once the limits of the modest cache were exceeded, however,



NEW LEASE ON LIFE: A 486 for \$399.

the improvement declined dramatically. On PC Labs' PC Bench 8.0 Processor test, the overall improvement measured about 52 percent, putting the performance midway between a 33-MHz 386 and a 33-MHz 486.

Getting that gain requires little pain. Cyrix provides two chip-removal tools that will pop out your old processor in a few seconds once you've opened your PC's case. Some PCs require you to remove expansion cards or the motherboard itself to gain access to the microprocessor socket. No motherboard, clock, or timing changes are required.

To prevent your making the only potentially fatal error—installing the chip in the wrong

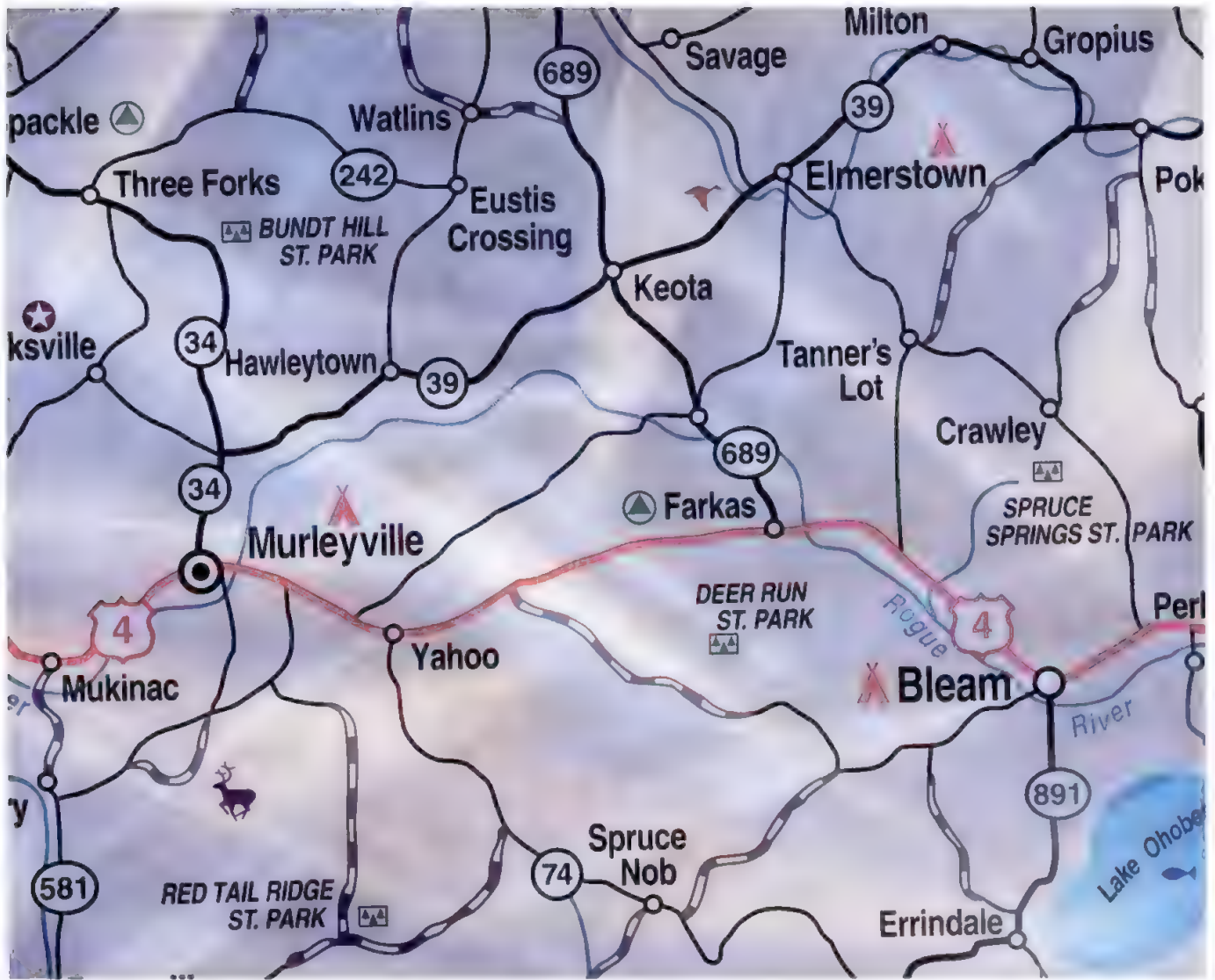
orientation—Cyrix gives you a bold sticker to mark the location of pin one on your motherboard. The new chip comes with a stick-on heatsink to help keep it cool, so you'll need about half an inch of clearance above the chip socket.

After installation, you add a couple of utility programs to your AUTOEXEC.BAT file to enable the cache. An installation program handles the necessary batch-file modifications.

The Cx486DRx2 rates as a viable upgrade solution: slower but easier than a motherboard transplant, less expensive but less satisfying than buying an entirely new system.

- List price: *Cyrix Cx486DRx2-33/66*, \$399. Requires: Any 33-MHz 386DX-based PC. Cyrix Corp., 2703 North Central Expressway, Richardson, TX 75080; 800-848-2679, 214-994-8388; fax, 214-699-9857.

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■ Communications

E-Mail Connection 2.0 Speeds Up and Smooths Out

BY DAVID HASKIN

ConnectSoft's \$99.95 E-Mail Connection 2.0 is an antidote for e-mail overload. Its single interface for communicating with many different e-mail systems will save serious e-mailers time and trouble.

The first version of E-Mail Connection suffered from its lack of support for some popular e-mail systems (First Looks, October 12, 1993). New in this version is support for cc:Mail; Lotus Notes; Prodigy mail; and messages collected by the Motorola NewsCard, a wireless PCM-CIA-based paging device.

In addition, ConnectSoft has added support for 9,600-bps MCI Mail and 14.4-bps CompuServe connections. E-Mail Connection also supports MHS and MAPI-compliant network systems.

Many of Version 1.0's rough edges are smoother now. For example, E-Mail Connection used to insist on displaying an annoying dialog box asking if you wanted to send or receive messages every time you dialed. That dialog box is now optional.

Still, a few interface glitches remain. Requesting a return receipt—which should require only clicking on a check box in the message editing window—still requires a trip through two levels of dialog boxes.

Nevertheless, E-Mail Connection's strong suit is convenience. Rather than learning multiple front ends for multiple e-mail services, with E-Mail Connection you can use one phone book for sending messages to all e-mail recipients and you can store all messages in the same set of user-defined folders.

If you subscribe to a public system that E-Mail Connection supports, it's a snap to exchange mail with virtually any other

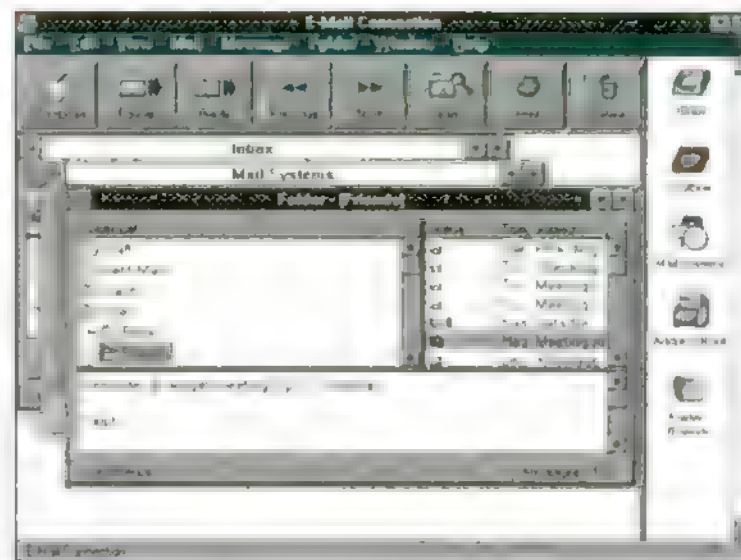
public system, such as the Internet and America OnLine. You just tell E-Mail Connection the recipient's address, and it's smart enough to route the message through the service's e-mail gateway automatically.

Other convenience features include the ability to poll periodically for messages and the ability to create user-defined rules to automatically file received messages.

With its support for addition-

al systems, E-Mail Connection can now serve most e-mail users as a universal front end. If you currently use a different program for each service, E-Mail Connection can be a real time- and hassle-saver.

• List price: *E-Mail Connection 2.0*, \$99.95. Requires: 4MB RAM, 5MB hard disk space,



ONE BOX: *E-Mail Connection* replaces multiple front ends with a folder-based interface.

Microsoft Windows 3.1. ConnectSoft, 6742 185 Ave. NE, Redmond, WA 98052; 800-234-9497, 206-881-8251; fax, 206-869-0252. Circle 434 on reader service card

■ Sound

Sound Blaster AWE32: Competing on the High End

BY GREG PASTRICK

A features war has broken out among sound cards. Creative Labs' new \$399.95 Sound Blaster AWE32 includes enhanced MIDI sampling, speech and voice processing, and special effects like 3-D surround-sound to help it compete with high-end companies like Turtle Beach.

Based on the E-mu Systems EMU8000 upgradable audio DSP, the AWE32 is a full CD-audio-quality card with 8- and 16-bit recording and playback, 32 simultaneous wave-table voices, standard FM music synthesis, and 128 general MIDI samples. Its programmable DSP features compression algorithms for processing text-to-speech data and enables the card's QSound surround-sound 3-D audio, along with reverb and chorus effects.

Creative Labs long ago mastered the art of fast and easy installation. Despite the half-dozen disks you have to load, it doesn't take much to get the new Sound Blaster up and running. Sound quality for the AWE32 is a close match for any card in its

price range, though the sharpness of its Roland MPU-401/MT 32-compatible MIDI output remains its obvious strength.

The AWE32's 10-channel mixer handles 4-watts per channel of amplified stereo output, while its complete array of I/O jacks give you a range of sampling and playback options. These include CD-ROM interface connectors for Creative Labs (Panasonic), and Sony and Mitsumi double-speed drives. In

addition, you get lines in and out for microphone, CD players, and speakers. The external MIDI port doubles as a joystick connector, too.

The Sound Blaster AWE32 represents a significant upgrade from existing 16-bit Sound Blaster cards, and that's what brings it closer to Turtle Beach territory.

• List price: *Sound Blaster AWE32*, \$399.95. Requires: 4MB RAM, 4MB hard disk space, Microsoft Windows 3.1. Creative Labs Inc., 1901 McCarthy Blvd., Milpitas, CA 95035; 800-998-5227, 408-428-6600; fax, 408-428-6611.

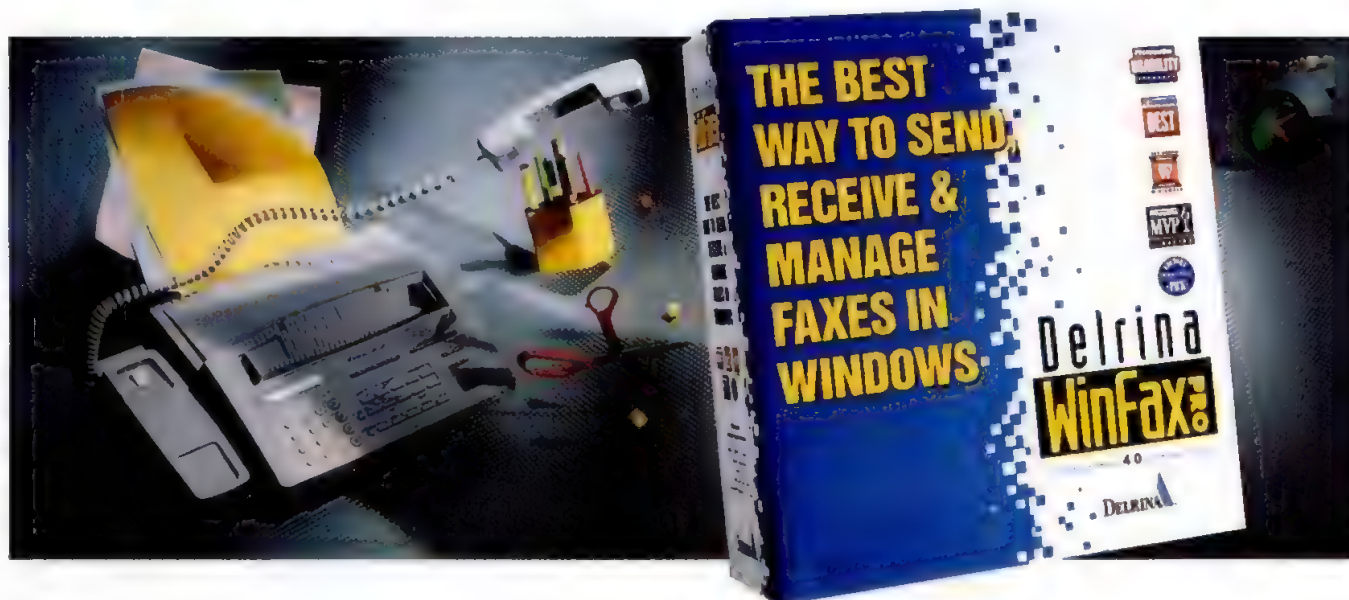
Circle 429 on reader service card

■ Sound Blaster Software

Supporting the Sound Blaster AWE32 is a suite of Windows-based software and DOS utilities. It includes

- ▶ VoiceAssist, which handles speech recognition from the AWE32's included microphone; and TextAssist, which handles text-to-speech conversions based on technology licensed from Digital Equipment Corp.'s DECtalk;
- ▶ QSound Virtual Audio, which lets you set up special sound effects (including 180-degree sound sweeps) from a simple action-button interface;
- ▶ WaveStudio, which gives you a complete set of .WAV file editing tools;
- ▶ Ensemble, a component-rack-like interface for controlling recording and playback of sounds;
- ▶ Cakewalk Apprentice for Windows, a sequencer program.—GP

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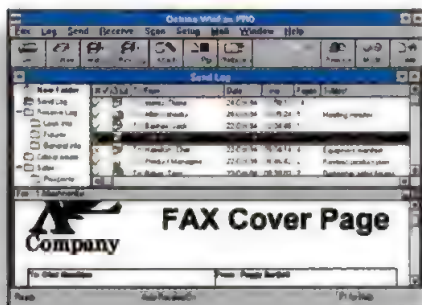
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*Requires Class 1 modem.

CIRCLE 250 ON READER SERVICE CARD

■ Multimedia

AVM's Summit: Big Sounds From a Small Box

BY DAVE SALVATOR

With its first entry into the high-end multimedia arena, AVM Technologies has scored big with the Summit, a General MIDI (Musical Instrument Digital Interface)—compliant external synthesizer in a "daughterbox" configuration. The Summit, which connects to a sound card, is ideal for corporate users seeking to dazzle with music in multimedia presentations, for home users getting serious about MIDI, and for anyone who wants vivid music behind their DOS and Windows games.

Using a Wave Table Lookup synthesis chip set from Kurzweil, this daughterbox offers nearly 370 very convincing *patches* (a programmed sound such as piano or cello), as well as digital

effects processing (reverb and chorus). While most professional-quality synthesizer modules and keyboards start around \$900, the Summit delivers these features at a low list price of \$389.

The Summit attaches easily to a sound card's joystick/MIDI port. After redirecting a MIDI application's output from your sound card's synthesis chip to the sound card's MIDI OUT port, the Summit is ready to rock and roll. Its 1/8-inch stereo jack readily connects to external speakers or a home stereo.

The Summit doesn't have any front-panel controls of its own, so a MIDI sequencer application or controller is used to send MIDI Controller Codes at the beginning of a sequence. These codes specify which patch set to use on each given channel.

At the time of this writing, the Summit doesn't ship with any software, but AVM will soon be bundling a MIDI sequencer application. The Summit's 32-note polyphony capa-

also controlled using a MIDI Controller Code. Several of the reverb settings suffer from too much echo effect and as a result are of little use, but most of the reverb and chorus options greatly enhance the Summit's overall sound.

AVM's implementation of MIDI Controller Codes requires an understanding of the MIDI environment and will be confusing for the inexperienced MIDI user, but the Summit's stellar patch sets are well worth the learning curve.

Whatever the application, the Summit's low price-point makes it a great way to get into high-end wave-table lookup synthesis. Hearing is believing.

• List price: *Summit*, \$389. Requires: *sound card with a 15-pin joystick/MIDI port or serial port. AVM Technologies Inc., 655 East 9800 South, Sandy, UT 84070; 800-880-0041, 801-571-0967; fax, 801-571-3634.*

Circle 426 on reader service card



MIDI SOUND:

The Summit plugs into your sound card.

bility (the number of notes you can play simultaneously) and 16-note multitimbrality (the number of patches you can play simultaneously) all but eliminate note "stealing," even during intense musical passages.

Like patch-set selection, reverb and chorus effects are

■ Multimedia

MediaRecorder Has Pro-Level Video-Editing Tools

BY MARK BROWNSTEIN

Lenel Systems' MediaRecorder for Windows is a useful utility for people who capture video in Windows, especially those users who have computer-controlled video equipment. The \$149 package provides more control for image capture than Microsoft Video for Windows' VidCap module delivers, and adds a few nifty tricks of its own. Control of special VCRs, camcorders, and laser-disk players is a bonus.

With MediaRecorder, you can set up time-lapse video cap-

tures, grabbing frames either in frames per second or seconds per frame. The .AVI files you create end up on a Capture Story Board, an editor that displays the



VIRTUAL BUTTONS: You can control your video equipment with your mouse.

first frame of each .AVI file. This thumbnail serves as a reminder of the clip's contents. You can arrange clips in any order and preview them individually or one after the other. The Story Board works only with clips captured in the current session; you can't add clips captured previously.

While control over the real-time capture process is useful, MediaRecorder's computer control capabilities make it even more valuable. We tested the program with a Sony CVD-1000 computer-controlled VCR, and MediaRecorder had no trouble controlling it.

Using your mouse (rather than the VCR's buttons), you

wind make it easy to locate any spot on a tape.

A sequence on tape that you mark for capture isn't actually captured; only the thumbnail is placed on the Storyboard. That way, you don't fill your hard disk with images that you may not really want, and you're not tying up system resources until you're ready to capture the video. Once

you choose the clips you want, MediaRecorder controls the capture process, advancing the tape to

the beginning of your clip, starting the capture, and then stopping it at the end.

• List price: *MediaRecorder*, \$149. Requires: *4MB RAM, 30MB hard disk space, Microsoft Windows 3.1, video capture board. Lenel Systems International Inc., 290 Woodcliff Office Park, Fairport, NY 14490; 716-248-9720; fax, 716-248-9185.*

Circle 427 on reader service card



SPICE AND DICE: Editing controls make custom video creation easier.

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Windows,
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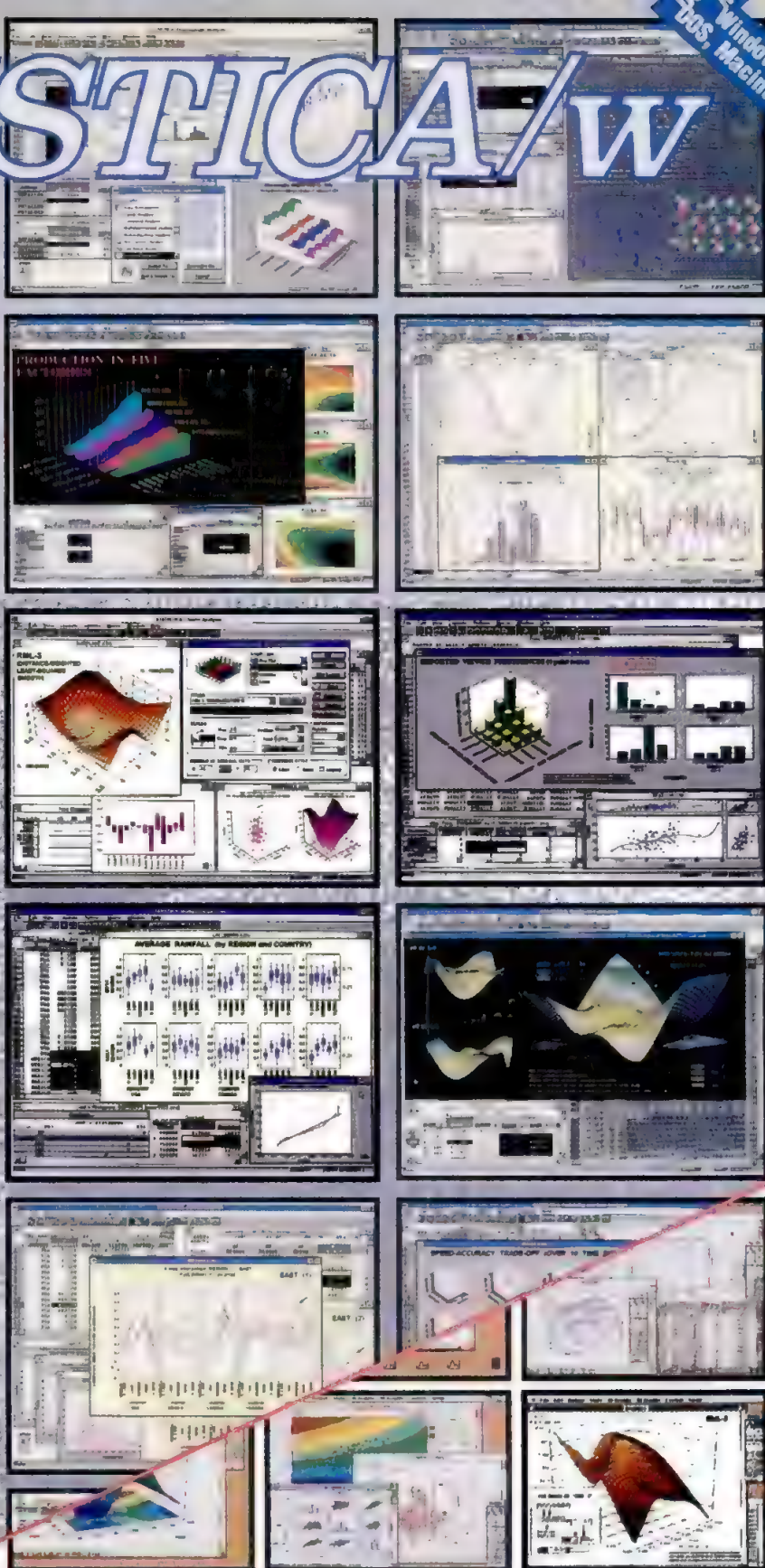


CIRCLE 057 ON READER SERVICE CARD

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\$4,129[†]



*Features included with some models. [†]List price, dealer prices may vary. Monitor not included. ¹The DX4-based HP Vectra VL2 PC available in May, 1994. ²Other capacities available. ³First year on-site, 24-hour service. Second and third year return to dealer. ⁴When available from Intel. ⁵The HP Vectra N, M, and XM come with MS-DOS® 6.0 and MS Windows 3.1 pre-installed, and the HP Vectra VL2 and XP come with MS-DOS® 6.2 and MS Windows for Workgroups 3.11 pre-installed; HP mouse and keyboard included. MS-DOS is a U.S. registered trademark and Windows is a trademark of Microsoft Corporation. Pentium and Intel Inside logo are U.S. trademarks of Intel Corporation.
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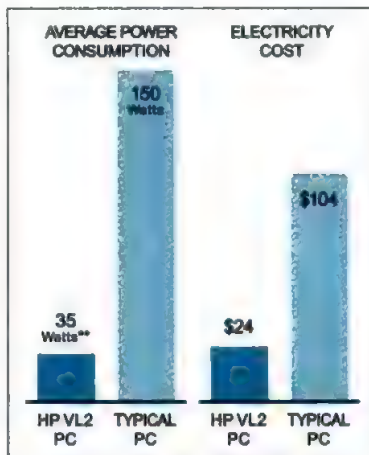
Green PCs that put you in the black.

What our new HP Vectra VL2 PC does for the environment is great. What it can do for your bottom line is astonishing. A thousand of these PCs could save your company \$80,000



a year in electricity bills. That's the kind of green everyone appreciates.

The HP Vectra VL2 can automatically switch from *active* to *standby* or *sleep* modes when not in use. That, combined with savings from our 14-inch Ergonomic 1024 monitor, cuts consumption from a typical 150 watts to 35 watts. Cutting annual energy costs about 75%. With no effect on performance.



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Annual electricity costs based on PCs (including monitors) running 24 hours a day. **Power consumption of the HP Vectra VL2 and HP 14-inch Ergonomic 1024 display (D2805A) in sleep mode. The HP Vectra VL2 daily usage reflects 3 hours active, 5 hours standby, and 16 hours sleep mode, for an average consumption of 35 watts. Potential annual cost savings based on 1,000 PCs using 35 watts each versus typical PC consumption of 150 watts. Electricity costs of 8 cents/Kwh assumed. Actual savings may vary. HP 14-inch Ergonomic 1024 display (D2805A) with Display Power Management System is used in calculation.

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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Adam A. Hicks

NEW

Cakewalk Home Studio: MIDI for the Masses

Musicians who use PCs to orchestrate MIDI (Musical Instrument Digital Interface) music are familiar with **Twelve Tone Systems'** Cakewalk Professional for Windows. Now, the arrival of Cakewalk Home Studio opens the door for amateur musicians to compose MIDI music. The Microsoft Windows-based entry-level MIDI sequencer and notation program lets you create, edit, or play back music via a sound card or external MIDI instrument. Numerous displays include a multitrack Staff view (print up to 16 staves on a single page), a Faders view (with real-time controls), and a Piano Roll view (with velocity display). With a .WAV-compatible sound card, you can embed and play back .WAV files from within a MIDI sequence.

• List Price: *Cakewalk Home Studio*, \$169. *Twelve Tone Systems Inc.*, 44 Pleasant St., P.O. Box 760, Watertown, MA 02272; 800-234-1171, 617-926-2480; fax, 617-924-6657.

Circle 405 on reader service card

NEW

Digital Dictation in Your Hand

With only two buttons and no moving parts, **Norris Communications Corp.'s** 3-ounce PCMCIA-compatible Flashback digital recorder will challenge any tape recorder you're presently toting around. Its 1MB flash memory modules, called SoundClips, are smaller than any form of magnetic tape available and record 30 minutes of 16-bit digital audio. Digital recording has several unique advantages. Messages are indexed so you can randomly access them, and it lets you play back messages at high speed or low speed while still retaining clear speech. You can also insert a note within a note.

• List price: *Flashback*, \$199.95. *Norris Communications Corp.*, 12725 Stowe Dr., Poway, CA 92064; 800-905-2225, 619-679-1504; fax, 619-486-3471.

Circle 406 on reader service card



Take a message with Flashback.

HOT PROSPECT

MECA's Desktop Financial Planner

After ten DOS versions, **MECA Software** has finally come out with a Windows version of its successful personal finance package, *Managing Your Money*. The Windows interface goes beyond the usual icons and pull-down menus to give you the look and feel of an office desk.



Managing Your Money for Windows tackles all the basic needs of the home user: transactions, investments, and financial planning. The program's checkbook displays and updates ledger and check register views simultaneously, and you can track the status of all types of investments from simple stocks to mutual funds (including appreciation, yield, and dividends). You're able to do budgeting, produce reports, and get expert advice from Andrew Tobias about how and why to make a financial decision.

Moreover, you can jump from the desk to the Windows Notepad or Calendar, or even configure the program to access your PIM, word processor, or calendaring software to create a single management center for your home PC.

• List price: *Managing Your Money for Windows*, \$79.95; upgrade from DOS version, \$29.95. *MECA Software Inc.*, 55 Walls Dr., P.O. Box 912, Fairfield, CT 06430-0912; 800-820-7458, 203-256-5000; fax, 800-944-6322.

Circle 404 on reader service card

NEW

Envelopes That Look as Good As Your Letters

The latest package in **Ace Software's** AtHome Series of easy-to-use task-specific databases, *AtHome Personal Post Office*, will replace the handwriting on your envelopes with professional bar codes and other extras for better presentation and faster delivery.

Personal Post Office's button-based interface makes it simple to type in a name and address for one letter or import existing information for bulk mail-merges. You can personalize packaging by importing .BMP, .PCX, or Targa files (or choose from 100 available clip-art images) or by adding text, which you can easily move or rotate. *Personal Post Office* supports a variety of printers, from dot matrix to laser, and many different types of envelopes and label sheets (including perforated post cards).

• List price: *AtHome Personal Post Office*, \$29.95. *Ace Software*, 1740 Technology Dr., #680, San Jose, CA 95110; 800-345-3223, 408-451-0100; fax, 408-451-0118.

Circle 407 on reader service card

NEW

Motorola's Envoy PDA Has Two-Way Wireless Communications

Motorola has combined its Dragon I-68349 processor, operating system software from Magic Cap, and a two-way wireless packet modem to create the 1.7-pound Motorola Envoy, its first standalone pen-based communications device. The Envoy provides the basic PDA suite of personal information management software (such as an address book, calendar, and spreadsheet), as well as two-way communication with several online services including America Online, AT&T PersonalLink Services, OAG's Flightline, and RadioMail, all preinstalled. The 480-by-320-resolution touch screen responds to pen or finger



The Envoy's 360-degree hinge lets the cover fold under.

New & Improved

using an on-screen keyboard and can capture freehand writing and drawing, but it doesn't support handwriting recognition. There are two Type II PCMCIA slots, a microphone to add short voice notes to files, a peripheral port (for printer or keyboard connection), and a rechargeable nickel cadmium battery.

- Estimated price: *Motorola Envoy*, \$1,500. *Motorola Inc., Wireless Data Group, 1201 E. Wiley Rd., #103, Schaumburg, IL 60173; 800-535-5775, 708-576-5000.*

Circle 408 on reader service card

NEW

AST Releases Its Version of Tandy's Zoomer PDA

AST Research's 1-pound 1.0- by 4.2- by 6.8-inch (HWD) Gridpad 2390 (the same unit that Tandy released last year as the Zoomer with marginal success) has an Intel 7.4-MHz 8086-compatible processor, comes standard with 1MB of RAM and 4MB of ROM, operates with Geoworks' GEOS operating system, has a Type II PCMCIA slot, and has a 3.25- by 4-inch screen with 320-by-256 resolution. It comes preloaded with many standard tools designed for ease of use and instant productivity, including Intuit's Pocket Quicken, a PIM from Palm-Computing, America Online, and even a few games for distraction. You connect your Gridpad through a serial port, an AST Research 9,600-bps modem (either internal PCMCIA or external pocket-size), or an infrared connection (available in June).

- List price: *Gridpad 2390*, \$549. *AST Research Inc., 16215 Alton Pkwy., Irvine, CA 92618; 800-876-4278, 714-727-4141; fax, 714-727-9355.*

Circle 409 on reader service card

IMPROVED

Central Point and PC Rx Stay One Step Ahead of Viruses

Assuming you routinely scan your system for viruses (and if you don't, you should), you're probably on the lookout for the most effective, up-to-date package. Two of the latest antivirus upgrades, from **Central Point Software** and **Trend Micro Devices**, work

BRIEFS

Accessories

DuraCartridge has redesigned the Hewlett-Packard toner cartridge by adding a larger hopper that can hold twice the amount of toner. At a price of \$189, it may cost more than you would pay for a normal single toner cartridge, but it will print twice as many pages with higher density than other cartridges can. 800-631-6769, 718-786-0400.

NoRad Corp., creators of the Ultra-Glass Universal Shields, have released the UltraGlass Form Fit Shields. Instead of using a top-mounted hinge, the new screens snap right onto the monitor. They still block extremely low-frequency (ELF) and very-low-frequency (VLF) electronic radiation (E-field) emissions and reduce 99 percent of screen glare while eliminating all static buildup. There are models for 12- to 21-inch displays with prices ranging from \$149 to \$299. 800-262-3260, 310-605-0808.

Get control of your multimedia sound boards with **SC&T International's** Platinum Sound Multimedia Volume Controller. Instead of reaching in back of your system or making software adjustments to control volume, this \$24.95 unit connects with any sound card to provide volume control using a knob at the front of your computer. You plug the cord into your sound card's speaker output connection and mount the dial to your PC with the included adhesive. 602-470-1334.

Kappa Type's MetaKey for Windows program will give you access to the full ANSI character set through your standard keyboard. You won't have to memorize Alt-key sequences in order to type special characters for Western European languages, fractions, and symbols. The package is compatible with all standard Windows word processing programs. List price: \$45. For sales information call Precision Type at 800-248-3668 or FontShop at 800-463-6687.

The Communications Shop's Just Dingbats turns your keyboard into a paint brush. The software allows you to type dingbats onto your page and

fast while defending your system from more varieties of viruses.

Central Point Anti-Virus 2.0 for Windows, adds a SmartCheck engine to its Virus Analyzer for faster scanning that operates in the background and more accurate checksum analysis so your program updates are not identified as viruses. The program can inspect compressed files (including support for .PAK, .ZIP, and Stacker formats) and can send alerts across a network using the CentralTalk communications protocol. Other network features include the ability to customize network setups and to distribute software updates remotely.

Alternatively, **Trend Micro Devices** has released its PC Rx 4.0, which features a rule-based detection technique called MultiClean. This process doesn't require updates to catch viruses that mutate into a second or third generation. Instead, the rule-based trap acts as a CPU emulator and tricks the virus engine into execution, then replaces infected files before the virus has a chance to spread. Version 4.0 also offers a preboot feature so your system won't boot if the program detects a memory-resident virus.

- List price: *Central Point Anti-Virus 2.0* for Windows, \$129.95. *Central Point Software Inc., 15220 N.W. Greenbrier Pkwy., #150, Beaverton, OR 97006; 503-690-8088; fax, 503-690-8083.*

Circle 410 on reader service card

- List price: *PC Rx 4.0*, \$69. *Trend Micro Devices Inc., 2421 W. 205th St., #D-100, Torrance, CA 90501; 800-228-5651, 310-782-8190; fax, 310-328-5892.*

Circle 411 on reader service card

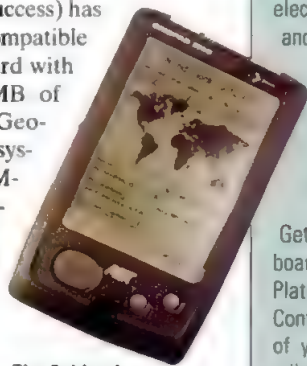
NEW

Free Your Pointing Device From the Desktop

Interlink Electronics' ProPoint lets you stand up straight, walk around, and still move your cursor. The hand-held, thumb-controlled pointing device is fully compatible with the Microsoft mouse driver and operates using a standard serial or PS/2 port. The unit uses Versa-Point's Force sensors to convert changes in pressure into cursor movement, and it comes with a 12-foot cord.

- List price: *ProPoint*, \$129. *Interlink Electronics Inc., 546 Flynn Rd., Camarillo, CA 93012; 805-484-1331; fax, 805-484-8989.*

Circle 412 on reader service card



The Gridpad 2390 joins the pen-based PDA race.



ProPoint: Let your fingers do the walking.

Speed Demon

STEALTH 64
\$399
 2MB VRAM
GRAPHICS ACCELERATOR



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June 1992
200



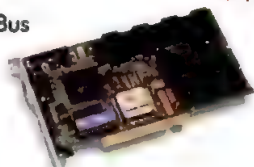
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Windows 3.1 performance tests performed by Diamond Computer Systems, Inc. using Ziff-Davis' WinBench Versions 3.11 and 4.0 on a Gateway Pentium-66 PCI system with 256k cache, 16MB RAM, 240MB IDE hard drive, SmartDrive 2048, and DOS 6.0. The Stealth 64 was configured with 2MB VRAM at 1024x768x256 colors 70Hz Large Font using driver release 1.00b. All trade names referenced are the service mark, trademark, or registered trademarks of the respective manufacturers. Diamond reserves the right to change specifications without notice. Copyright © 1994 Diamond Computer Systems, Inc. 1130 East Arques Avenue, Sunnyvale, CA 94086, 408-736-2000, Fax: 408-730-5750. ST64 AD 110

CIRCLE 176 ON READER SERVICE CARD

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The Desktop Application Director (DAD) makes it easy to switch between applications and commonly-used tasks.

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for Windows**

**Borland Quattro Pro 5.0
for Windows**

**Borland Paradox 4.5
for Windows**



NEW

Multimedia Help Speaks Louder than Text

Reading documentation is a chore whether it's hypertext or not, but **Blue Sky Software Corp.** can turn on-line help into entertainment. Multimedia WinHelp supports 256-color graphics, .AVI video files, and .WAV audio, all of which you access in real time directly from within a Windows .HLP file. As in Windows Help, the links you create appear as highlighted text or on special buttons, but you can also use Multimedia WinHelp to create standalone presentations. Targeted at the nonprogrammer, the program features a Media Bagger to browse and choose video and sound clips and a runtime version of Microsoft Video for Windows 1.1 (so you can run video on any standard VGA screen). It doesn't require you to use a Windows Help Authoring Tool. Included in the price is a royalty-free license to distribute runtime Multimedia DLLs.

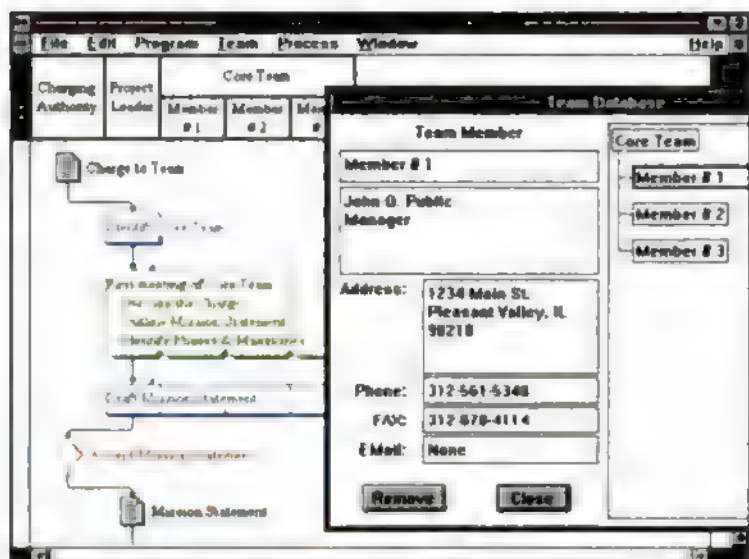
• List price: *Multimedia WinHelp*, \$199. **Blue Sky Software Corp.**, 7486 La Jolla Blvd., #3, La Jolla, CA 92037; 800-677-4946, 619-459-6365; fax, 619-459-6366.

Circle 413 on reader service card

NEW

TeamFlow Is More than Just Lines and Symbols

CFM created early versions of TeamFlow while consulting with companies on how to restructure workflow. Now in Version 3.1, TeamFlow does more than just give you drawing tools; it assists you in the creation of workflow processes. As you build relationships between items (such as team member, task, and goal), TeamFlow draws lines connecting them. More importantly, it redraws them as new elements are added or old elements are changed.



TeamFlow draws a color-coded flowchart from information you enter into the team database.

BRIEFS

Accessories

then change their styles as you would with a normal font. The first package is called Signs and Symbols and contains 150 EPS images representing many common road signs, safety warnings, and other symbols. Other packages will be available in the future. List price: \$69.95. 800-733-1650, 716-473-1650.

Hardware

Microtek Lab, a recent Editors' Choice recipient in our color scanner review, ("In Living Color", February 8, 1994) brings out two new well priced models, one with 36-bit color and one with 24-bit color. You can reach Microtek at 800-654-4160 or 310-297-5000.

ScanMaker III (\$3,499) outputs 36-bit color and includes color calibration and correction software as well as Adobe Photoshop 2.5. The scanner uses ASPI drivers, works with most SCSI controllers, and supports 600 by 1,200 dots per inch and documents up to 8.5 by 14 inches

ScanMaker IIHR (\$1,499) is only capable of 24-bit color but otherwise is comparable to the ScanMaker III in features. You get the same software, compatibility, dpi resolution, and an only slightly smaller document size capacity (8.5 by 13.5 inches), all at a great price.

Fujitsu Computer Products of America has a new bargain dot matrix printer for home- or small-office users. The \$299 DL1150 Home-Office PrintPartner has 15 built-in fonts, runs at four printing speeds, and supports 360-by 360-dpi resolution. The 7.6- by 18.1- by 9.8-inch (HWD) printer is designed to share your desktop silently and connects via a serial or parallel interface. 800-626-4686, 408-432-6333

Near perfection in your display is possible with **Phillips Consumer Electronics Company's** Brilliance 21A 21-inch color monitor, but at a price. The \$3,499 monitor includes an auto-scanning digital system called CyberScreen, which controls the monitor's beam current for sharp, accurate, and bright displays with maximum miscon-

You can create multiple layers for any task (for example, underneath "File Claim" you can create a diagram of the claim process). TeamFlow will also let you embed commands to launch other applications.

• List price: *TeamFlow 3.1*, \$395. **CFM Inc.**, 60 The Great Rd., Bedford, MA 01730; 800-647-1708, 617-275-5258; fax, 617-275-7008.

Circle 414 on reader service card

IMPROVED

High-Speed Document and Image Management

ImageFast 2.0, from **ImageFast Software Systems**, hides its underlying database operations behind a file-cabinet interface for friendlier and faster document and image management. The package provides Microsoft Access Database Design Wizards to help you create your own indexing format and Calera's OCR engine to OCR documents quickly and accurately. You can automatically create and index new documents without leaving ImageFast, and perform tasks such as optical character recognition, printing, and faxing (if you have a fax card installed) by dragging and dropping files.

The software lets you route files or even complete file cabinets to other users, and includes a simple e-mail feature that can track a document's workflow. Also added to Version 2.0 is an optional module for creating censored text within documents for legal or security reasons.

• List price: *ImageFast 2.0*, single user version, \$195. **ImageFast Software Systems Inc.**, 7926 Jones Branch Dr., #260, McLean, VA 22102; 800-899-6665, 703-893-1934; fax, 703-893-7499.

Circle 415 on reader service card

IMPROVED

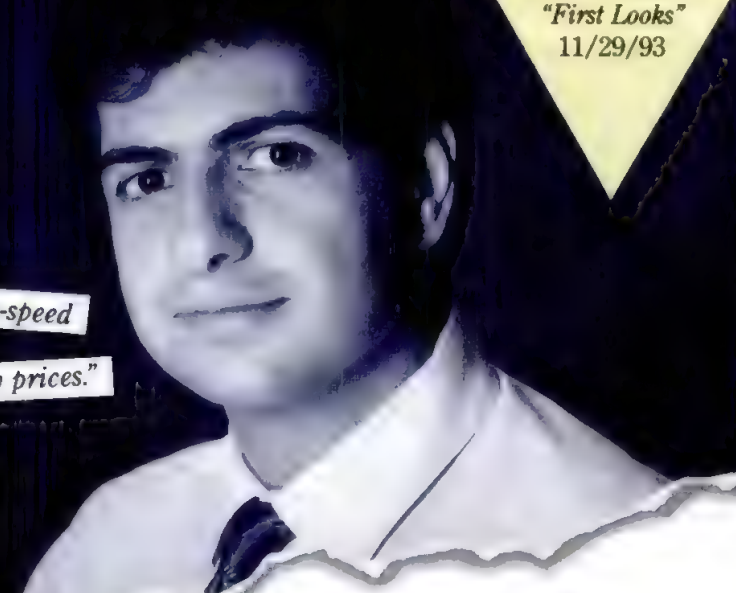
MapInfo 3.0 Features Better Images and More Data Analysis

Version 2.0 of MapInfo for Windows, from **MapInfo Corp.**, combined mapping and data analysis well, but Version 3.0 does it better with raster image support, enhanced thematic analysis, and intelligent data-driven buffers. And new button bars bring formerly hard-to-reach functions out into the open.

Satellite raster images enable you to see natural terrain on-screen and actually chart new roads or other details onto outdated maps. You can also import data remotely using SQL DataLink. This data can be displayed in thematic maps or charts in a broad range of colors.

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"First Looks"
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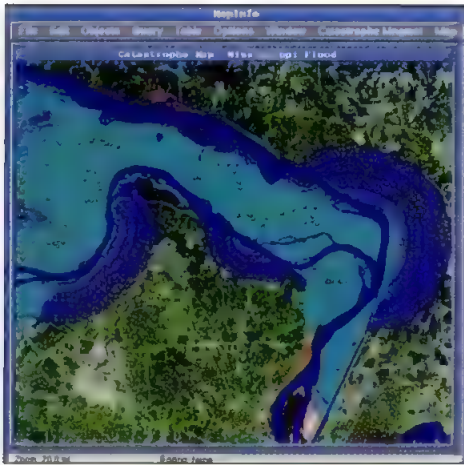
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New & Improved



The MapInfo program imports data from client/server networks.

Enhanced buffering lets you combine two data buffers in order to define yet another range from the overlapping sections.

• List price: *MapInfo for Windows, Version 3.0*, \$1,295; upgrade from previous versions, \$299. MapInfo Corp., One Global View, Troy, NY 12180-8399; 800-327-8627, 518-285-6000; fax, 518-285-6070.

Circle 416 on reader service card

NEW

Polaris Hopes Its Low-End PIM Has an Advantage Over PackRat

Polaris Software has stumbled badly with recent versions of its PackRat PIM (personal information manager), but now it's attempting a comeback with *Polaris Advantage*, a lower-end PIM that doesn't include some features (such as macro writing) found in its older, bigger sibling. It does, however, have PackRat's contact, schedule, and task management, all in a file-folder interface that helps you access information and allows you to change the layout of the screen easily.

Advantage can share data with a variety of Windows word processing, spreadsheet, and fax applications, and the program lets you associate Windows or DOS files with contacts or events, save them with 100-character filenames, and launch them without leaving Advantage. The package can also export data to PDAs and supports printing in many paper organizer sizes and formats (including Day-Timer, Day-Runner, Franklin Day Planner, and FiloFax).

• List price: *Polaris Advantage*, \$149. Polaris Software Inc., 15175 Innovation Dr., San Diego, CA 92128-3401; 800-975-7895, 619-592-7400; fax, 619-592-7430.

Circle 417 on reader service card

BRIEFS

Hardware

vergence of .15 mm and brightness uniformity of 90 percent. The Brilliance 21A unit supports up to a 76-Hz refresh rate at 1,280-by-1,024 resolution and a horizontal scanning frequency as high as 82 kHz. 800-835-3506, 310-217-1300.

And Finally...

Fujitsu has announced it will support the Public Windows Interface (PWI) designed to make the Microsoft Windows application program interface an open, published standard. . . . **Palindrome** has adopted the System Independent Data Format (SIDF) as its sole format for storing LAN data. . . . **Automap** has shipped a CD-ROM version of its *Automap Road Atlas*, which covers roads throughout the United States. . . . Also new on CD-ROM is **Peachtree Software's** version of its business accounting software. . . . Does your PCMCIA make the grade? **New Media Corp.** has marked out five requirements for a PCMCIA card to be called plug-and-play: (1) The card is not required at boot-up. (2) The card must be hot-swappable. (3) Software must be present to make the machine "card-aware" at all times. (4) You must be able to configure the card across system resources and different platforms. (5) If the card is accessed but is not present, an error message will appear instead of the system crashing. . . . **American Cybercasting Corp.** has opened an electronic newsstand on the Internet starting with daily ASCII e-mail delivery of USA Today and Moscow News. For more information call 216-247-0770.

Great Plains Software has taken complete responsibility for further development of the Microsoft Profit accounting and business-management package it codeveloped with Microsoft.

Another accounting agreement comes from **Moses Computers and Computer Associates**, who have collaborated to create a bundle that will include CA-BPI Accounting II software and a MosesALL! starter kit two-person network. . . . And lastly, hearty congratulations go out to the **Fairmont Hotels**, who have finally upgraded their phone systems to handle 14.4-bps data transmissions, a most welcome improvement for notebook-carrying travelers.

IMPROVED

Cardiff's Teleform Simplifies Form Creation

Cardiff Software got attention for Teleform for Windows 2.0, which turns fax machines into automatic form-processing centers. The latest version, Version 3.0, is easier to use, with new toolbars, a grid view for form alignments, the ability to view multiple documents on one screen, and support for unlimited font types and colors on a form. A new scripting tool makes it easy for you to program your fax machine to read data from forms sent to you and automatically create and send back a confirmation fax. In addition, you'll see faster optical character recognition of upper- or lowercase letters and numbers, as well as support for unconstrained hand-printing recognition. Version 3.0 operates with a scanner or any Group III fax machine.

• List price: *Teleform 3.0 for Windows, single-user package*, \$1,495; upgrade from Version 2.0, \$249. Cardiff Software Inc., 531 Stevens Ave., Bldg. B, Solana Beach, CA 92075; 800-659-8755, 619-259-6430; fax, 619-259-6450.

Circle 418 on reader service card

IMPROVED

Presenting: Six Ways to Add On to Bravo

A series of six add-on packages for **Alpha Software Corp.'s** Bravo presentation package give you the raw materials to look creative even if you're not. Alpha sells all six add-ons but only developed two of them, Add-On Design and Alpha Photo Pack. Bravo Add-On Design provides you with prepackaged presentation styles including fonts, backgrounds, colors and effects. Each Alpha Photo Pack contains 50 photographic images for you to use as backgrounds or clip art.

The other four add-ons are remarketed from other companies. Power Album contains 1,000 pieces of clip art and an organizer that lets you view a thumbnail of the art before you place it. Power Fonts contains over 100 TrueType font outlines. There are also two add-ons to help with your prose: Correct Quotes (over 5,000 contemporary and historical quotes) and Just Joking (one-liners indexed by author or topic).

• List price: *Bravo Add-On Designs*, \$9.95; *Alpha Photo Packs*, \$12.95 each; *Power Album*, \$24.95; *Power Fonts*, \$19.95; *Correct Quotes*, \$14.95; *Just Joking*, \$14.95. Alpha Software Corp., 168 Middlesex Tpke., Burlington, MA 01803; 800-451-1018, 617-229-2924; fax, 617-272-4876.

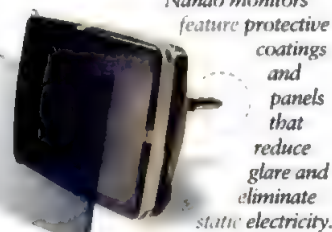
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Superior In Every Detail.



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At Nanao, details make all the difference in creating our family of professional display monitors. From the product design and manufacturing that takes place in our factory to the end user's working environment, Nanao pays attention to every detail. In engineering. Assembly. Product testing. Quality control. Shipping. Customer support. From the very first days of the company, we set out to be an innovator in monitor technology. And, in a few short years, we have achieved that goal. Today, Nanao has the lowest repair rate in the monitor industry, the highest product reliability, and a fast-growing number of enthusiastic customers. So if you're looking for a superior monitor, start with the details. We do.



Nanao monitors feature protective coatings and panels that reduce glare and eliminate static electricity.



Nanao T Series and F Series monitors have captured every major award from the industry's leading publications.



Nanao was the first monitor company to join in partnership with the EPA Energy Star Program.

Model	Size	Dot Pitch	Scan Frequency	Recommended Resolution
1888				
1890				
F 1800W				
F 1800W				
F 1800W				
F 1800W				
F 1800W				
F 1800W				

Our monitor family teams ultra high resolution with a list of impressive technical specifications.

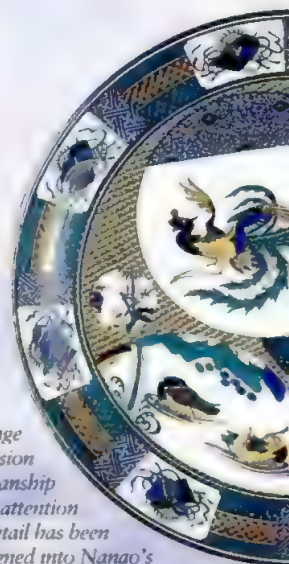


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When industry leaders coined the term "Plug and Play," they had products like Z-STOR in mind. Z-STOR is so easy to operate, switching the power on and off is all you need to worry about. And it automatically reconfigures itself at start-up whenever you add users or change drives. Plus, with Personal NetWare™ pre-loaded, the Z-STOR integrates seamlessly into the corporate NetWare® environment.

Expanding Z-STOR is easy as well. Its PCMCIA slot accommodates a high-speed modem for remote access, a Token Ring adapter or system recovery

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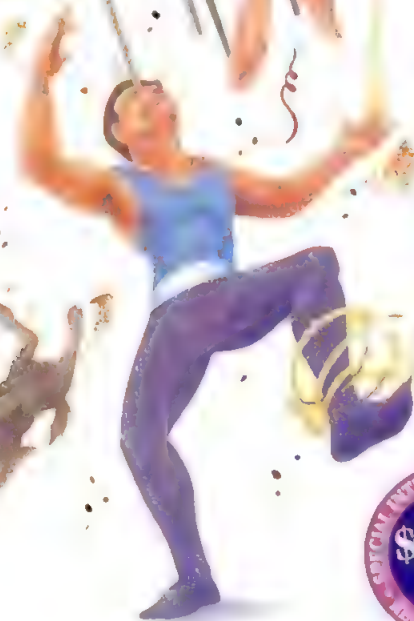
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Timelines for precise control over multimedia events.	Yes	Not	Not	Not
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Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Tin Albano

Unraveling the Secrets of Windows NT

BY SHERYL CANTER

Microsoft Windows NT may look a lot like 16-bit Windows on the outside, but it's quite different on the inside. NT offers 32-bit performance, enhanced security, built-in networking, preemptive multitasking, cross-platform portability, and true protected-mode memory management for greater system stability. These books on NT will help both novices and programmers take full advantage of NT and its new features.

Oriented toward the new user, Craig Stinson's *Running Windows NT, Version 3.1* is a comprehensive book that runs more than 1,200 pages. It's divided into five sections: the user interface, networking, security and administration, running applications, and system maintenance.

Running Windows NT covers, in patient detail, basic concepts such as logging off, task switching, and moving and sizing windows. There are boxed "tips" throughout the book that can help beginners become power users; both the new features of NT, such as Mail and Schedule+, and those found also in 16-bit Windows are discussed.

By contrast, *Peter Norton's Windows NT Tips and Tricks*, by Peter Norton and Peter Kent, is an excellent choice for the experienced Windows user who's ready to move over to NT. It covers only NT-specific features and assumes that the reader is already knowledgeable about

those features that are shared with 16-bit Windows.

The book starts with a readable overview of NT—what makes it new and different. Next, the authors discuss the issues that must be considered before even loading the new operating system: the availability of hardware drivers, which file system to use, system administration, and passwords.

The meat of the book includes topics such as the new Administrative Tools group in the Program Manager and the new applets it contains, the groupware programs Mail and Schedule+, the "hidden" applications SYSEDIT and REGEDIT, and detailed information about network management. A chapter entitled "Neat Stuff" covers multimedia and games.

IF YOU'RE A PROGRAMMER

For programmers looking for a comprehensive guide to NT, there's *Mastering Windows NT Programming*, by Brian Myers and Eric Hamer. This extremely well-written book focuses on the aspects of NT programming that differ from 16-bit Windows programming. The book's special

strength is the background and context it brings to each topic discussion. After giving an overview of NT's internals, highlighting its new features, and comparing these features with those of Windows 3.1, the book tells you what you need to build an NT program and gives you detailed information about porting from Win16 to Win32.

The book then moves into advanced NT programming topics: threads, structured exception handling, processes, pipes, virtual memory management, new graphics features, system security, Unicode, and more. Each chapter starts with background information—explanations of the technology and how the features differ from those in Windows 3.1—and then moves into a discussion of the APIs (application programming interfaces).

If you prefer to dispense with background discussions and move directly into programming details, you'll like Martin Heller's *Advanced Win32 Programming*. It focuses on the transition from Win16 programming to Win32 programming. Heller goes beyond a simple rehashing of the Win32 API to give many practical programming tips; his hands-on experience is obvious.

Since, as Heller points out, the differences between the Win16 and Win32 APIs can be hidden cleanly behind class libraries, he

devotes two entire chapters to making the transition from C to C++; he starts with general concepts and then goes on to discuss MFC (Microsoft Foundation Classes). Borland's OWL (Object Windows Library) for NT was not yet finalized at the time this book was published, so it is not covered.

The new features of NT are introduced in a whirlwind tour of threads, processes, and advanced graphics that Heller brings together with the help of a sample program that is included on the companion disk. An understanding of NT concepts is assumed. OLE 2.0, the multimedia features of NT, and other topics are covered in later chapters.

Those with a solid background in the underlying concepts of Windows NT will appreciate the book's clear, deft style; those needing more explanation will get lost.

• **Running Windows NT, Version 3.1**, by Craig Stinson, with Mike Blaszcak, Bruce McKinney, and JoAnne Woodcock, \$27.95; Microsoft Press, 800-227-4679; ISBN: 1-55615-572-7.

Circle 441 on reader service card

• **Peter Norton's Windows NT Tips and Tricks**, by Peter Norton and Peter Kent, \$27.00; Random House Electronic Publishing, 800-733-3000; ISBN: 0-679-79200-7.

Circle 442 on reader service card

• **Mastering Windows NT Programming**, by Brian Myers and Eric Hamer, \$44.99; Sybex Inc., 800-227-2346; ISBN: 0-7821-1264-1.

Circle 443 on reader service card

• **Advanced Win32 Programming**, by Martin Heller, \$44.95; John Wiley & Sons Inc., 800-225-5945; ISBN: 0-471-59245-5.

Circle 444 on reader service card



Read Only Recommends

Hiring competent Windows programmers is difficult, but *The 1993 Guide to Evaluating and Selecting Windows Programmers: Separating the Comedians from the Gurus* can help. It lists questions to ask programmers, followed by the correct answers. \$39.95; SmoothVision Software Inc. Publication Series, 800-832-0098.

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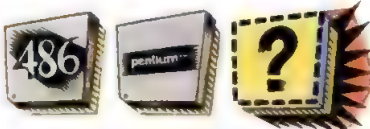
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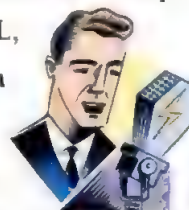
Standard equipment, of course, includes the Compaq commitment to quality, dependability and value. Which comes in the form of our free three-year warranty* and our free seven-day,

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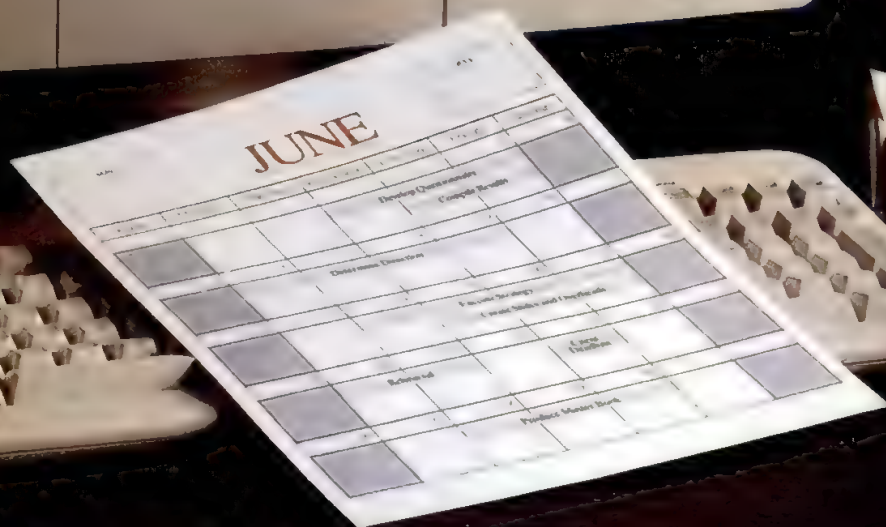
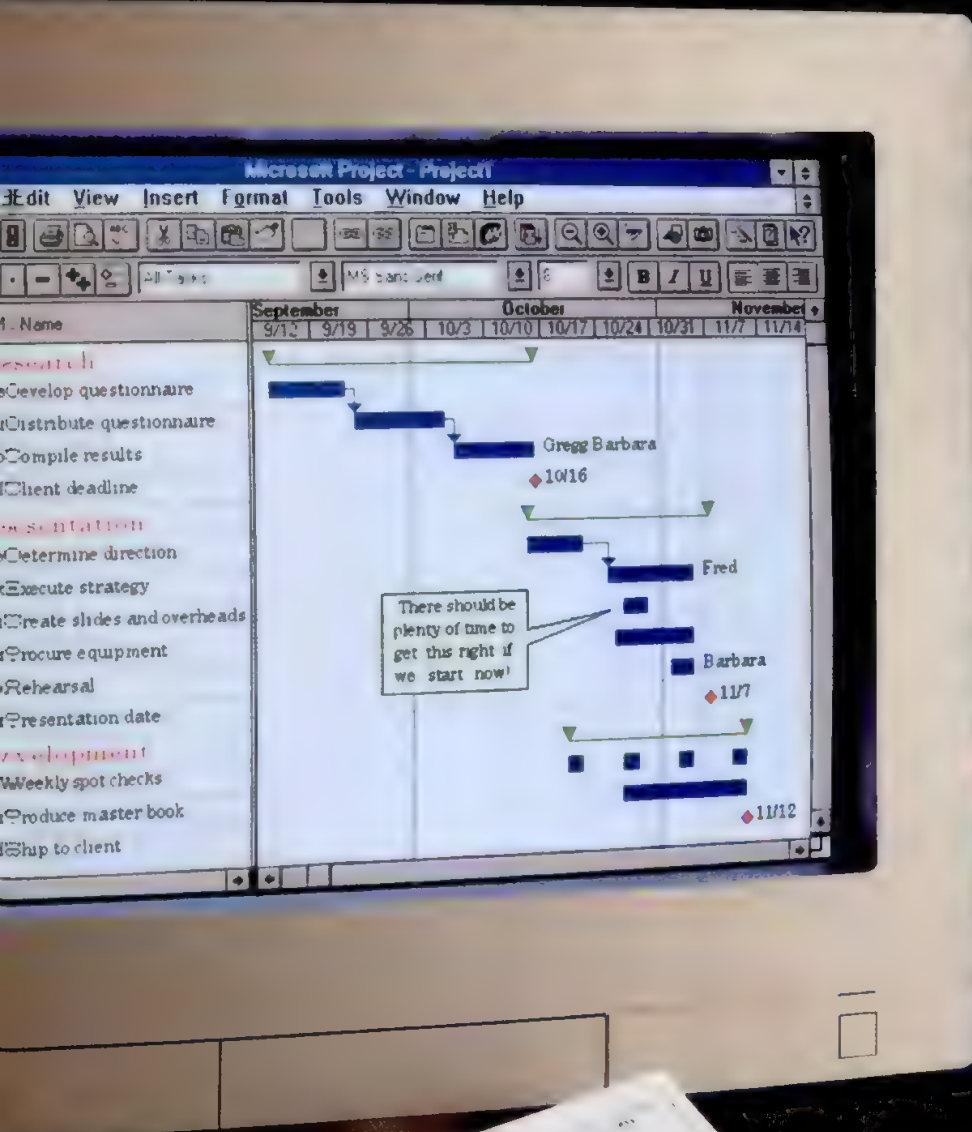
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COMPAQ

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Now there's software that helps you do it more effectively than ever.

It helps you plan, manage and communicate with ease.

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Michael J. Miller

The Great Chip Race

The competition between RISC chips and CISC chips has gotten so heated that people are now lining up on different sides. Add the PowerPC from Apple, IBM, and Motorola to the fray and the contest to see which kind of architecture will win out

becomes the PC industry's hottest sporting event.

Currently, Intel and Intel-compatible chips dominate the industry. These are called CISC (complex instruction-set computing) chips because they use many complex instructions to run applications. The alternative to CISC is RISC (reduced instruction-set computing), a newer approach that says chips can run faster if they have fewer, simpler instructions. RISC chips—notably the PowerPC family—have gotten a lot of attention lately, particularly with the introduction of Apple's new Power Macintosh line. Similar talk comes from backers of the MIPS chip and Digital's Alpha chip, who state that their chips are already faster, and can evolve more rapidly, than today's Intel-compatible processors.

You might expect RISC chips to overtake CISC chips in the near future, so I thought we should wander down to the racetrack and see for ourselves what the odds are that RISC-based machines will surpass CISC-based systems in any given amount of time.

HORSE #1: CHANGING HORSES IN MIDSTREAM

Time frame: 12 to 18 months. In this scenario, RISC systems prevail over CISC systems, with buyers needing only one look at the PowerPC to be immediately won over. They stop buying Intel-compatible PCs and start placing all of their orders for RISC-based machines, notably Power Macintoshes. Apple's market share doubles or triples overnight. Software vendors scramble to port their code and PC makers rush to convert their lines, leaving CISC-based systems as relics of an earlier time.

While anything is possible, this seems a bit far-fetched. It assumes that buyers will ignore things like compatibility and application availability to climb

on the RISC bandwagon. Even if RISC systems remain much faster than CISC systems, I believe it will be a while before enough applications appear to cause a large-scale shift. *Odds: 1,000 to 1.*

HORSE #2: SEATTLE SLEW

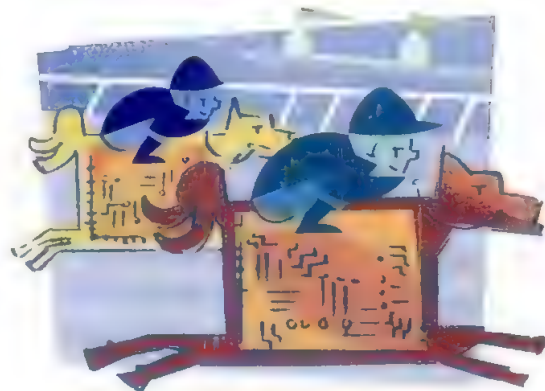
Time frame: 18 to 36 months. In this scheme of things, almost all software developers make sure their applications run well on the Chicago version of Microsoft Windows over the next 12 to 18 months. As a result, they write a lot of Win32-based code which runs directly on Windows NT/Intel platforms.

Then they realize that porting NT from Intel- to RISC-based systems is fairly easy. If enough RISC-based systems exist to make it worthwhile to test and support the apps (a relatively small investment compared with starting from scratch), there will in turn be enough apps created to generate a greater demand for RISC systems.

This scenario is based on a lot of assumptions: Win32 applications must port cleanly from Chicago to NT and then from Intel to RISC; such applications must run markedly faster on RISC systems; and at least one NT/RISC platform must have a big enough market share in the next 18 months to warrant vendors going through the quality assurance and support process. *Odds: 5 to 1.*

HORSE #3: A HORSE OF A DIFFERENT COLOR

Time frame: 24 to 48 months. In some respects, this scenario is a more radical version of the previous one, with a horse that looks more like a zebra. It will have blue stripes from IBM, multicolored stripes from Apple, and pink stripes from Taligent (the Apple/HP/IBM joint venture).



Tomorrow's processors are ready to run, and the race is about to begin. Place your bets.

Michael J. Miller

This proposition says that developers and power users are rapidly going to embrace object-oriented technology, microkernel-based architectures, and new frameworks for writing applications. This widespread acceptance will cause the next generation of great applications to be written in a very different way from today's Windows applications.

Developers try using the Taligent framework or the OpenDoc compound document specification, both of which work well across multiple platforms, including Apple Macintosh, IBM Workplace OS, and Microsoft Windows. They then use these tools to target Windows first (to serve the existing market), with a goal of moving easily to other operating systems on other platforms. The ports turn out to be quick, the applications run faster on RISC systems, and everyone jumps on the bandwagon.

This is clearly the dream of Borland, IBM, Lotus, and WordPerfect. But it seems like a long shot because so much effort is currently going into Windows development and

because much of this new Apple/HP/IBM technology is still in the "slideware" phase. *Odds: 20 to 1.*

HORSE #4: PHOTO FINISH

Time frame: somewhere between 48 months and never, but it's hard to tell. In this scenario, Intel adds enough RISC features to its chips and RISC vendors add enough CISC features to their chips that no one can tell the difference between CISC and RISC.

The line between CISC systems and RISC systems is already blurring. The Pentium has a number of features that were once associated solely with RISC systems (for instance, superscalar operations, in which the chip can execute more than one instruction per clock cycle). The newest Pentium was designed to make symmetric multiprocessing much easier, and speculative execution (in which the chip figures out the result of certain instructions in case they are needed) may be on the drawing board for the next generation of Pentium processors.

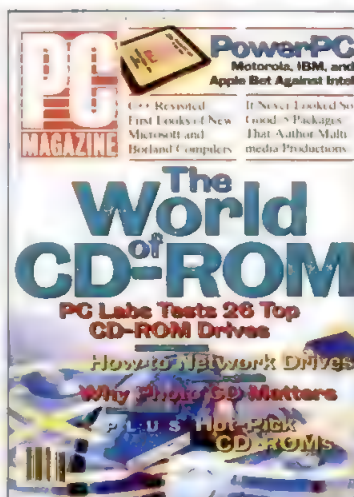
Intel will continue to incorporate RISC-like features into its x86 chips, and someday its processors may even embrace RISC

entirely with an x86 core along just for compatibility.

Similarly, the PowerPC family diverges from the traditional definition of reduced instruction-set computing. RISC chips, in theory, have 128 instructions or fewer; the PowerPC has over 200. That's far fewer instructions than the Pentium but still steps a bit into CISC territory. And there's been speculation that IBM might add an x86-compatible section to some future PowerPC processor.

As these things happen, the RISC/CISC debate may well become a moot point. Operating systems are likely to become available on multiple chips, and applications are likely to become more portable. Of course, users will still have to determine for themselves which OS running on which chip will bring them the most compatibility and performance. This will move the debate away from technical specifications and more into the everyday world of price/performance and compatibility.

To me, this seems the most probable outcome. After all, as the number of transistors on a chip grows, the line between RISC and CISC blurs, leaving us with a more gradual transition. *Odds: 3 to 2.* □



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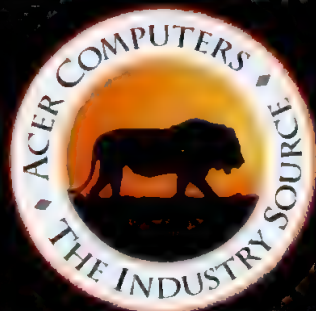
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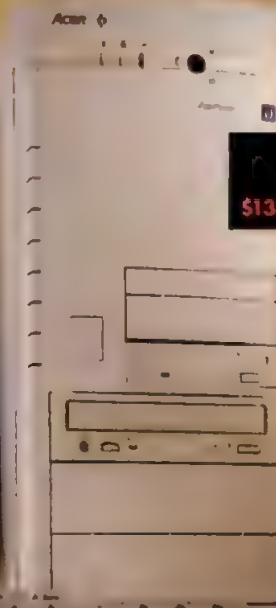
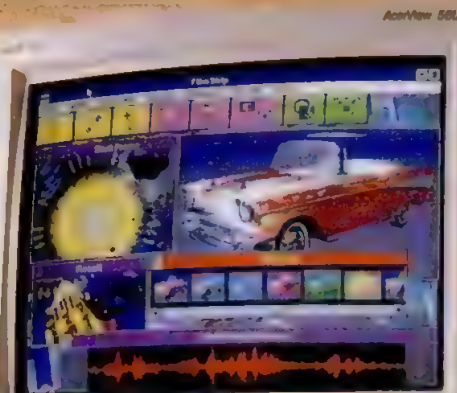


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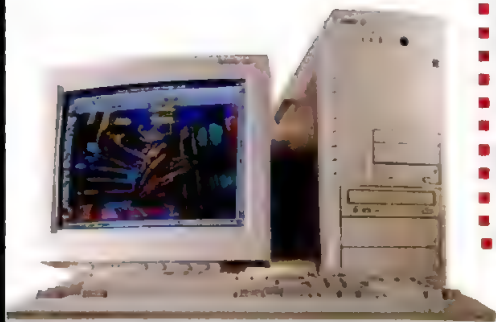
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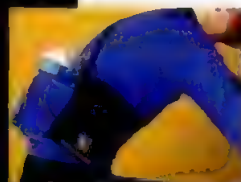
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Bill Machrone

The Internet Beckons

I felt like the last person to get onto the Internet. With all of the talk about electronic superhighways and whatnot, I felt I was missing something. Not that I don't get enough electronic mail via Lotus Notes, MCI Mail, and CompuServe/ZiffNet. Not that

I don't spend enough hours on-line browsing databases and engaging in electronic conversations. I still felt that there was something missing; that people were having some kind of metaconversation that I kept hearing about but couldn't participate in.

The obstacles to getting onto the Internet are many and varied. If you just want to see what's going on out there, I recommend you try one of the service providers with an Internet link, such as Delphi or The Pipeline. Even then, you won't see all of it. Different services tap into different aspects of the Internet. You might be most interested in the news groups, the ongoing conversations that range from the sublime to the ridiculous. Or you may want to see the incredible array of information out there in graphical and hypertextual form; if so, you want to be part of the World-Wide Web.

One of the technical analysts at our sister publication, *PC Week*, has put up a Web server. Through a high-speed data line and some truly interesting Firefox software that runs TCP/IP over a NetWare LAN without having the TCP protocol stacks loaded on individual machines, I can access that server and the Web. The Web is inherently multimedia. It understands a variety of text, hypertext, graphics, and sound files. The viewer interprets some of these files directly and loads programs dynamically to allow you to view/see/hear other formats.

One of the best windows onto the Web is a program called Mosaic (reviewed in *First Looks*, April 26, 1994); it runs on PCs, Macs, and X Window terminals. Written by Chris Wilson at NCSA (the National Center for Supercomputing Activities, located at the University of Illinois), Mosaic is a work in progress that is freely distributed to encourage more widespread use of the Web. Virtually every component

is available as freeware, including a public-domain version of Unix. The Web itself was designed at CERN (the European Organization for Nuclear Research) and has become an international standard.

The best way to describe the Web is as a trip to the library, but you've never been in one like this before. The shelves are run by different volunteers and vary greatly in their offerings. Each shelf is on a different server, in far-flung locations. In the course of browsing, you cross oceans and continents. The Internet does it all quickly and conveniently—the electronic equivalent of seven-league boots.

A DOLLOP OF HUMOR

The Web servers are run largely by college students. Thus, you must be prepared for a heavy dollop of quirky humor with your information. The prevailing ethic of running a Web server is that you provide a home page (with information about your organization and the kinds of things on the server) and a personal page (with information about yourself). Most system operators include scanned photos of themselves, their families, their dogs, and so on. Others get quite artistic. The portrait of one

fellow at Michigan State University, for instance, is a rather ominous close-up of his eye. Another is silhouetted against a snow-dappled mountain peak.

Even commercial servers have some public-service files or popular files to cut down on network traffic. One of IBM's Web servers, for example, has a database of missing children on it.

Unlike MCI Mail, where the emphasis is on mail messages, or CompuServe or America Online, where conversation rules the day, the Web is essentially read-only. You can leave comments for operators and fill out the



Getting onto the Internet isn't always easy, but it's the ultimate fix for the info-junkie.

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Bill Machrone

occasional form, but the emphasis is on navigation and information retrieval. The stunning thing is the nearly infinite variety of information. You can read or download academic and scientific papers, track the progress of standards committees, get answers to FAQs (frequently asked questions) on almost any topic, and get access to many electronic reference materials. What you won't see is much copyrighted material, at least not in written form.

HORNY GEEKS?

Pictures are a different story. You'll find an incredible array of scanned photographs on virtually any topic. Nobody seems very worried about copyright, especially when you've crossed borders and the server is in another country. For instance, one server has a sub-directory filled with JPEG and .GIF images of Cindy Crawford. Every time she appears in any publication, some devoted fan dutifully scans the image and loads it in. This particular server, which also has a lot of pornography, has access limits. You can wear out your welcome by downloading too many images. The operators warn that if you come back too frequently you will make their "Top 50 Horny Geeks" list.

You can also see the leading edge of communications technology. Internet Talk Radio, for example, is a downloadable sound file of weekly interviews with movers and shakers in government and industry. If you have the right equipment and a high-speed connection, you can see live television from MIT's Media Lab. Magazine-format Web servers are growing in popularity. You can catch up on all the latest music-industry gossip on MTV.COM, which is run by video jock Adam Curry. You can download Doctor Fun, a daily cartoon in the same vein as *The Far Side*, from servers at the University of Chicago or the University of North Carolina. Michigan State University has an interactive weather map; you click on the desired region of the country to get a forecast for that area. The Internet is rife with such experimentation, and the World-Wide Web is at the forefront.

RESOURCES

The easiest way to get onto the Web is to use an existing Internet connection to FTP (download) a copy of Mosaic to yourself from ftp.ncsa.uiuc.edu. You can reach Delphi at 617-491-3342, Firefox at 408-321-8344, and The Pipeline at 212-267-3636. □



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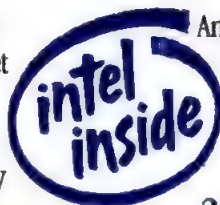
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John C. Dvorak

The Information Cow Path

I've been running around the country doing radio talk shows to plug my book, *Dvorak Predicts* (gratuitous plug intended), and what do you suppose is the most commonly asked question? "What the heck is the so-called information superhighway?"

I tell them it's a crock of bull cheese dreamed up by the vice president that has somehow become synonymous with the Internet. The result has been a lot of confusion, a booming Internet, and an even more booming business in books about the Internet. If the Internet is the information superhighway, then we're all in trouble. By allowing every Tom, Dick, and Harry access, the Internet will become the central clearinghouse for hate groups, neo-Nazis, Communist wanna-bes, sick cults, spies, and kiddie-porn activists. It's not close to being out of control. It is out of control. But golly, information should be free, so I guess it's okay, huh?

We have no information superhighway because the phone companies have been sitting on the technology needed to digitize the phone network: ISDN (Integrated Services Digital Network). Thanks to a curious antidigital mentality in this country (has anyone but me noticed this?), we have yet to see digital phones, television, or radio.

So recently I was sitting down with some executives from Pacific Bell who were pooh-poohing ISDN. "It's not what you want; you want broadband!" "You mean broadband ISDN?" "No, just broadband." "You mean ATM, the asynchronous transfer thingamajig technology that's the rage?" "You got it!"

Oh, right. When will I get broadband at my home? In the year 2150? My account representative tells me, "Your area is scheduled to get ISDN in the fourth quarter of 1996." I'm smack-dab in the middle of the San Francisco Bay Area, 2 miles from one of the largest universities in the world, and I'll get ISDN at the end of 1996? I can't imagine when it's scheduled for the outskirts of Bakersfield, California. Oh, I'm looking for-

ward to getting broadband. Yeah, maybe my grandchildren will get it.

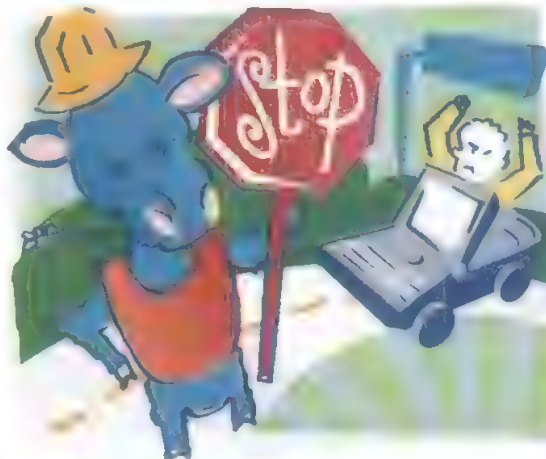
Folks, the experiment to deregulate the phone companies is over! The idea was to create competition through deregulation. What competition? Where can I get ISDN other than from Pacific Bell? I can call U.S. West to ask for ISDN in California. But in my experience, those people have never heard of ISDN.

These systems should have been in place country-wide by now. Pacific Bell is working on all sorts of multimedia projects and trying to find a way to compete with cable TV. It's spending money on a zillion non-phone-related projects such as electronic delivery of video games and movies. I want ISDN. Phone companies weren't deregulated so that they could open up supermarkets and shoe stores. They were deregulated so we'd get better service.

I subscribed to the deregulation philosophies of the last decade. And I think they taught us all a lesson. Public utilities have to be regulated by smart committees with foresight. Maybe over time these committees get filled with lackeys and stooges and degenerate into flocks of yes-men. Maybe it's good that deregulation

breaks up this parasitic relationship. But now we can regulate anew with fresh blood.

ISDN implementation is the key to the information superhighway, and the current implementation is pathetic. If the phone companies were told to do it (or else!), we'd all be linked digitally already. This would give us a competitive edge over the rest of the world. Instead, we have a mess. Phone companies are experimenting with electronic delivery of games. Communication is more important than games. Somebody better tell them soon.



Pacific Bell execs tell me I can't get ISDN until the end of 1996. Are they nuts?

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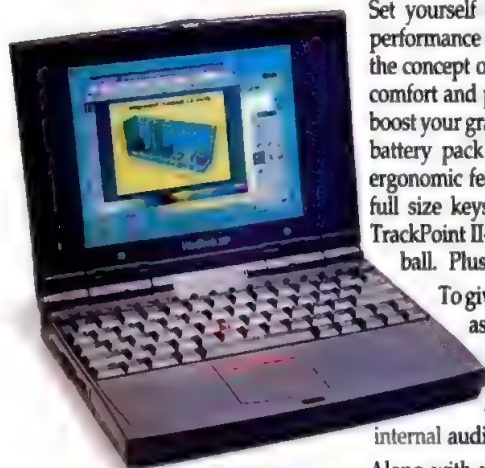
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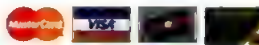
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Inside Track

T

he PowerPC and the future of computing.

Now that Apple has released its PowerMac and the reviews are in (fast native applications, slow emulation), when can we expect to see **serious** PowerPC-based machines on the PC side of the fence?

And when will we see the **vaunted combo machine** that efficiently runs both Mac apps and PC apps like a champ?

Personally, I don't expect to see any cost-effective combo machines, and I don't see much of a market for them. If I have a Mac and a bunch of good Mac apps, what do PC apps (which I probably can't figure out anyway) bring to the party? And what PC user wants to use Mac apps? **So forget it.** It would just mean too many fonts **clogging** up the computer's hard disk.

As for the PowerPC challenging Intel's Pentium: In theory, it should be a no-brainer to take on Intel, match it, and then beat it. The handicap is the **lack of a cohesive vision** at IBM. Big Blue has to lead the way here. Too many old chiefs and not enough young Indians. **So forget it.**

Windows über Alles Dept.: The IBM lack of vision is exemplified by **incredible support** of Windows at every turn (Microsoft executives are laughing now), while OS/2 takes a **backseat**. Most recently, the Lexmark Windows-at-Work-based laser printer was introduced for \$1,399. It's a **killer** 600-dot-per-inch, 8-page-per-minute printer called the WinWriter 600 that's designed to optimize printing for Windows users. **Hot indeed.** For an encore, IBM will hit its big toe with a hammer.

Mo' Money, Mo' Money, Mo' Money Dept.: Meanwhile, Microsoft is under **intense scrutiny** from its supporters, as it recently sent out a fancy invitation asking "smart" users to cough up \$39 a year for **better support** than they're now getting. It's called Microsoft Plus. For your money, you get six newsletters, "Express Service" phone support, notification of new updates (you pay for this?), access to a special CompuServe forum, some discount coupons, and a free videotape of Bill Gates talking about the future. One joke going around says that if you **send an extra \$10** you don't get the videotape.

You'd think Microsoft would provide all these things as part of regular support, wouldn't you? In the front of its little brochure, Microsoft quotes Thoreau: "**A wise man will not go out of his way for information.**" I think a quote from P.T. Barnum may be more apt.

Genuinely Interesting Software Dept.: Yes, here's what you've been looking for. The company is V

*In theory, it should be
a no-brainer for the
IBM PowerPC to
challenge Intel's Pentium.*

*In reality,
IBM has no cohesive
vision. Too many old
chiefs and not
enough young Indians.*

Communications Inc. (phone, 800-648-8266, 408-296-4224; fax, 408-296-4441). The product is called **System Commander**, and it's \$99.95 (Reviewed in First Looks, April 12, 1994). It allows you to **boot 42 different operating systems on a single machine**—16 versions of DOS and 26 other Intel-compatible operating systems. This is a bit more interesting than those boot managers that allow you to load different CONFIG.SYS files, don't you think? It's **perfect** for the small developer who has to test his software against Microsoft Windows, Windows NT, OS/2, Unix, Novell DOS, and whatever else is targeted. Want to make sure your code runs under Windows 3.1 running on top of DOS 5.0, 6.0,

6.1, 6.2, and 6.3, as well as the OS/2 VDM? Here's the program for you. **Hot-n-spicy habanero software.** Highly recommended. By the way, if you're going to have all those operating systems on the same machine, make sure to have a **mongo** hard disk.

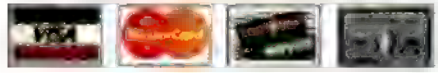
And Now for Something Completely Different Dept.: Some years back, the famous graphic designer Herb Lubalin began a publication called *U&I*, a tabloid highlighting the typefaces designed by International Typeface Corp. Over the years, ITC would dream up remarkable typefaces and use them in all sorts of creative ways in the magazine. Anyone interested in fonts could get numerous ideas from this publication. Most of today's **modern** typographical designs began with Lubalin and his type pals in New York and elsewhere. Lubalin died a few years back and much of the energy in the type world **scattered**. I've always hoped other type companies would take the hint and produce a publication akin to the early *U&I*. Adobe took a few cracks at it but seemed to miss the mark. Now there's something from FontHaus called x-Height, which contains interesting and entertaining articles about type and its use. Worth a look for any of you out there who are **addicted to playing with fonts**. A subscription is \$15 a year. For more information, contact FontHaus in Fairfield, Connecticut, via phone at 203-367-1993 or fax at 203-367-1860.

Sheesh Dept.: How come this doesn't happen more often? Drew Spencer sent an interesting observation into CompuServe that is a great **Crazy Mistake**. (Yes, another edition is due soon.) Apparently a woman calling the Dell support line said she couldn't turn on her computer. As Drew walked her through the process, she mentioned that **she was pushing the foot pedal over and over** and nothing was happening. Wow. It was the mouse. It's such a logical mistake for some newcomer to make that **I'm stunned** I've never heard it before. Go figure. □

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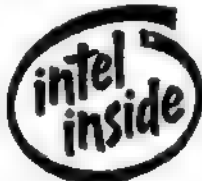
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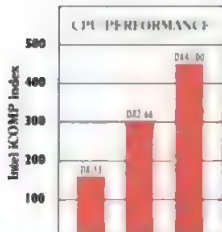
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- ✓ Easy upgrade to PCI
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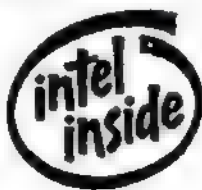
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Jim Seymour

Docking Stations for the Real World

Whether or not you agree with the notion that notebooks are going to replace most desktop PCs over the next three or four years, you've surely noticed how many of your coworkers have begun relying on notebooks as their only PCs.

It's satisfying to see predictions come true, and I feel good about this one, having argued since the mid-eighties that the move to notebooks—not as extensions of desktop machines, but as the sole computers for many of us—is inevitable.

The evolution has taken longer than I expected, though. There have been obstacles along the way, including the power lust of those who insist on having the most powerful machines extant on their desks. If you're addicted to power lust, read no further; the most powerful desktops will always outmuscle even the most capable notebooks.

Of course, there's computer power, and there's the power of computing. Many dyed-in-the-wool PC addicts have come to appreciate this second kind of power: the power of always having your computer with you. Side benefits abound, such as not having to worry whether you have the latest version of a file, and not wasting time on file transfers in the office.

A well-designed docking station is the key to using a notebook PC as your only machine. Long-time readers may wonder how I can say that with a straight face, for I have railed against docking stations for years, accusing them of being too big, clumsy, and expensive.

I still feel that way about most docks. But over the past few months, I've relied extensively on a powerful notebook PC and a wonderful, intelligently designed new docking station, which together have persuaded me that the problem isn't the idea of docking stations but too many me-too implementations.

We've seen three paradigms for docking stations. The oldest, adopted some time ago and still in use by Compaq and Toshiba, was the "let's turn your notebook into a lousy desktop

PC" box. This thing waddled onto your desktop; asked for a conventional monitor, keyboard, and mouse; had one or more slots and bays for bigger hard disks and expansion cards (perhaps including a network interface card); and confirmed Seymour's Theory of Inverse Synergy: More Is Less.

Next came port replicators—little strips that duplicated the connections on the back panel of your notebook PC. With a port replicator, you could more easily attach and detach all those things you needed to plug into the notebook to use it at your desk. Whenever you left your desk, a quick turn of a couple of thumbscrews freed the port replicator and all its dangling wires, and you were on your way.

Then came Apple's PowerBook Duo and Desktop Dock. This automated the process by working much like a videocassette and VCR. You just stuck your closed Duo into the maw of the Dock, and it was sucked down into the unit, where connections were made automatically. You could add a conventional monitor, keyboard, and mouse, and you'd have room for a disk or tape backup unit inside the Dock.

Each of these approaches represented a step forward, but in retrospect they seem like only small steps. They reflect the old way of looking at notebook PCs as limited, compromised devices you use only because you can't haul a nice monitor, desktop keyboard, mouse, and network connection around with you.

Wake up, PC makers, the world has changed. Today, many notebook PCs have very good displays, keyboards, and built-in pointing devices. With PCMCIA slots, many have internal network connections, too. So why do docking station designers continue to act as if it's 1985 and



A well-designed docking station is the key to using a notebook PC as your only machine.

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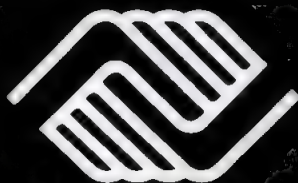
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Jim Seymour

notebook PCs are things we want to put at arm's length the minute we walk in the door of the office?

A NEW APPROACH

The notebook PC I've been using for the past few months is the IBM ThinkPad 750C—a fast, powerful box with a 33-MHz 486SL CPU, a big and bright 256-color SVGA active-matrix display, a fine keyboard, the TrackPoint II pointing device, a 340MB hard disk, and 20MB of RAM. It's a better, more enjoyable PC to use than 99 percent of the desktop systems I've worked on. In sum, it's not something to avoid using as is; it's a very satisfying system.

And for this 750, IBM has designed the first docking station that really makes sense. It has the requisite ports for external monitor, keyboard, and mouse, but it clearly doesn't expect you to use them. Rather, it assumes you want to flip up the display on your notebook and go to work with the same screen, keyboard, mouse, and hard disk you always use, whether you're at the desk or on the road.

Instead of trying to overcome the notebook's nonexistent limitations, the IBM Dock 1 adds additional capabilities some of us need, whether in the office or not: a CD-ROM drive, a SCSI port, and external stereo speakers with a beefy amp (the 750s have basic sound systems built in). There's also automatic battery charging. Half-round speaker enclosures peek out from beneath opposite ends, so that the assembly looks like nothing so much as two big black hamburgers with your PC mashed down into them. In all, the Dock 1 forms an attractive base for the 750C.

IBM's designers understand that the role of the desktop docking station in the 1990s isn't to trash the mediocre human-interface parts of the computer—parts long since gone from notebooks worth owning—and replace them with traditional ones, but to add functions not yet built into the basic machine. That design approach, combined with the relatively light weight of the Dock 1 (about 6 pounds) delivers the best of both worlds. The result is a powerful extension of your notebook's capabilities that can nonetheless travel with you when necessary. All in all, the Dock 1 is one of the most intelligent PC products I've ever used.

I'm beginning to believe there's something to this "new IBM" stuff after all. . . . □



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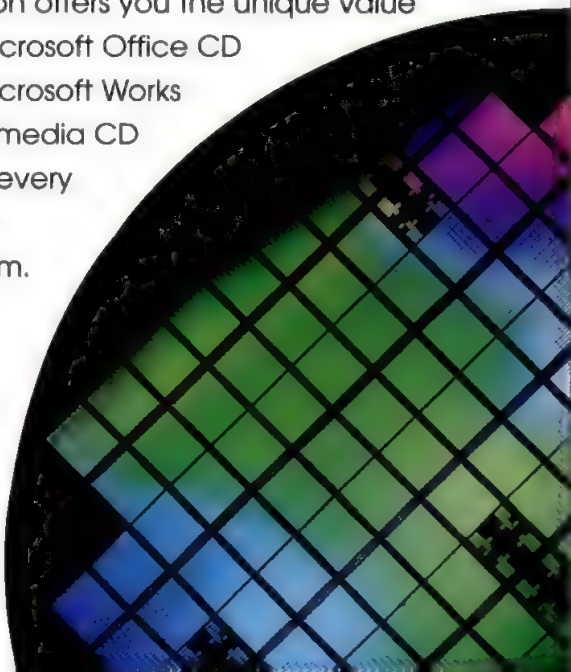
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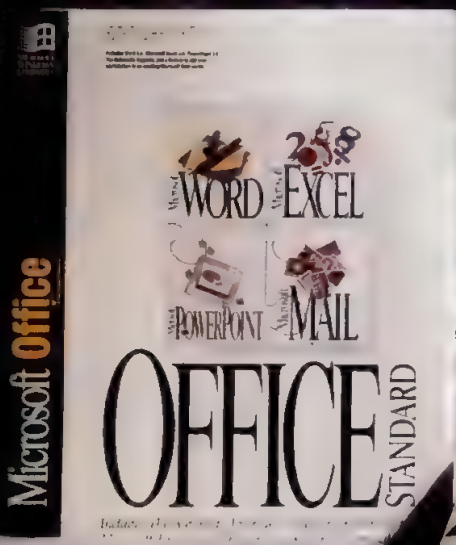
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--- PC Magazine, April 26, 1994

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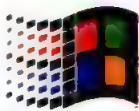
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Bill Howard

Talking to My Keyboard

The most interesting new piece of technology I've seen so far this year is... a *keyboard*. Seriously. And no, it hasn't been a slow year for technology. It's just that we need to recognize that technology means more than the PowerPC, ATM, and the

PCI bus. Technology also encompasses thoughtful industrial design that allows for more useful, less complicated hardware and software products.

CORRALLING CABLES, CORDS, AND WIRES

The keyboard on the new high-end Compaq Deskpro XL is a near-perfect execution of this second kind of technology. The Vocalyst keyboard, as Compaq tags it, integrates a mouse connector, microphone, microphone jack, speaker, and volume-control wheel. A cable-capture system houses long mouse and keyboard cables, so instead of three or four skinny cables snaking out the back of your PC, you have one modestly thicker all-in-one cable.

Without much effort, a typical system can breed a dozen cables interconnecting a PC, monitor, keyboard, mouse, printer, modem, external CD-ROM drive, speakers, and power cords. What a mess! That's the biggest advantage of the new Compaq keyboard: less clutter.

Macintosh fanatics are quick to point out that their beloved Macs have offered mouse ports on keyboards since time immemorial. Point noted. But now they're available for the rest of us. Under the Vocalyst there's a standard PS/2-style connector that Compaq's mouse connects to, and the mouse cable comes out from either the left or right side of the keyboard. Any excess cable can be wound around a series of S-shaped channels found on the underside of the keyboard.

THIS KEYBOARD SOUNDS GOOD

The Deskpro XL's sound system is a compromise, but on the whole it's a pretty good compromise. Inside the PC is the functional equivalent of the Microsoft

Sound System, and on the keyboard is a microphone and a single speaker. Nobody's going to mistake the Vocalyst's sound output for a pair of Bose or Altec Lansing speakers, but it's there, it's worlds better than any internal PC speaker, and it has a negligible impact on the overall cost of the system.

For business audio—annotated documents, voice input, and speech synthesis—the setup is perfect. In case you want better sound in and out of the system, there's a microphone jack on the keyboard (one less cable you have to snake around to the back of the system unit) and a pair of standard speaker jacks on the PC.

Another nice touch is the volume-control wheel on the keyboard. If you've dabbled in multimedia, you know that every sound source seems to vary dramatically in loudness. With most sound systems, you have to either have a volume-control dialog box always on-screen or constantly fiddle with the volume-control shortcut keys—if you can remember what they are.

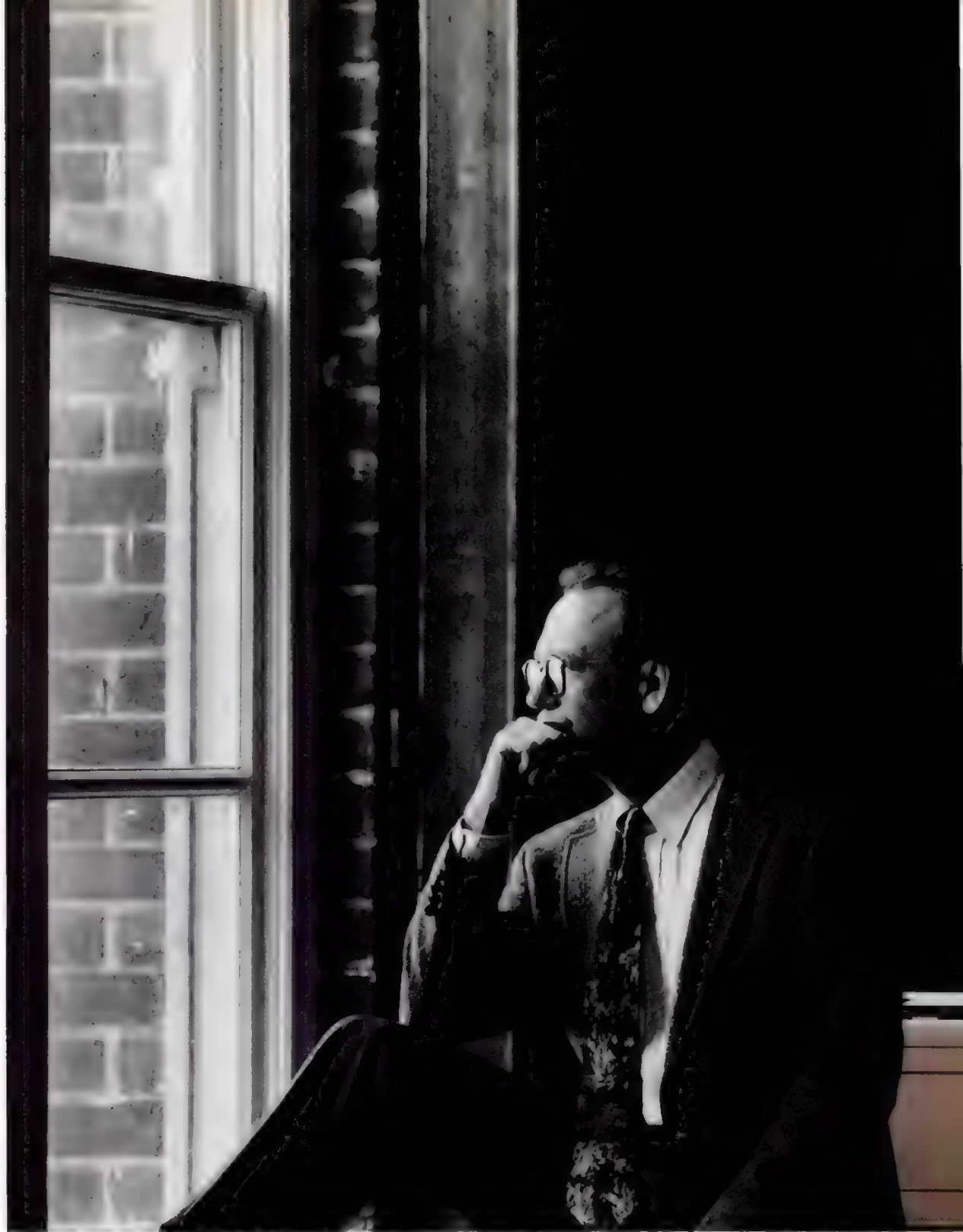
THE PC TO BEAT, THE KEYBOARD TO COPY

The rest of the Compaq Deskpro XL has also been pretty well thought out, down to a finished underside so the small-footprint chassis can be turned on its side and used as a mini-tower. Compaq engineers, however, should have figured out a way to rotate the drive bay cluster 90 degrees when the unit is used as a mini-tower (inserting CDs vertically is a little awkward). I think the Deskpro XL will be the high-end machine to beat in 1994, but it won't be cheap.

Finally, Compaq needs to move the Vocalyst keyboard all the way down its product line as quickly as possible. There are no patents to stop other vendors from imitating the multifunction keyboard, and they should. Pronto. □



Sometimes the simplest advances help the most. Compaq's new keyboard is a great example.



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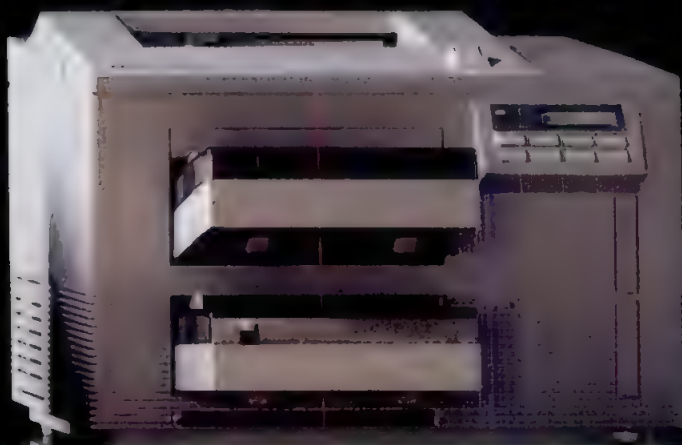
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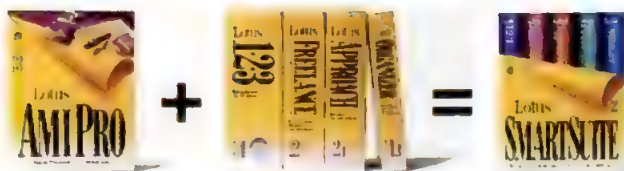
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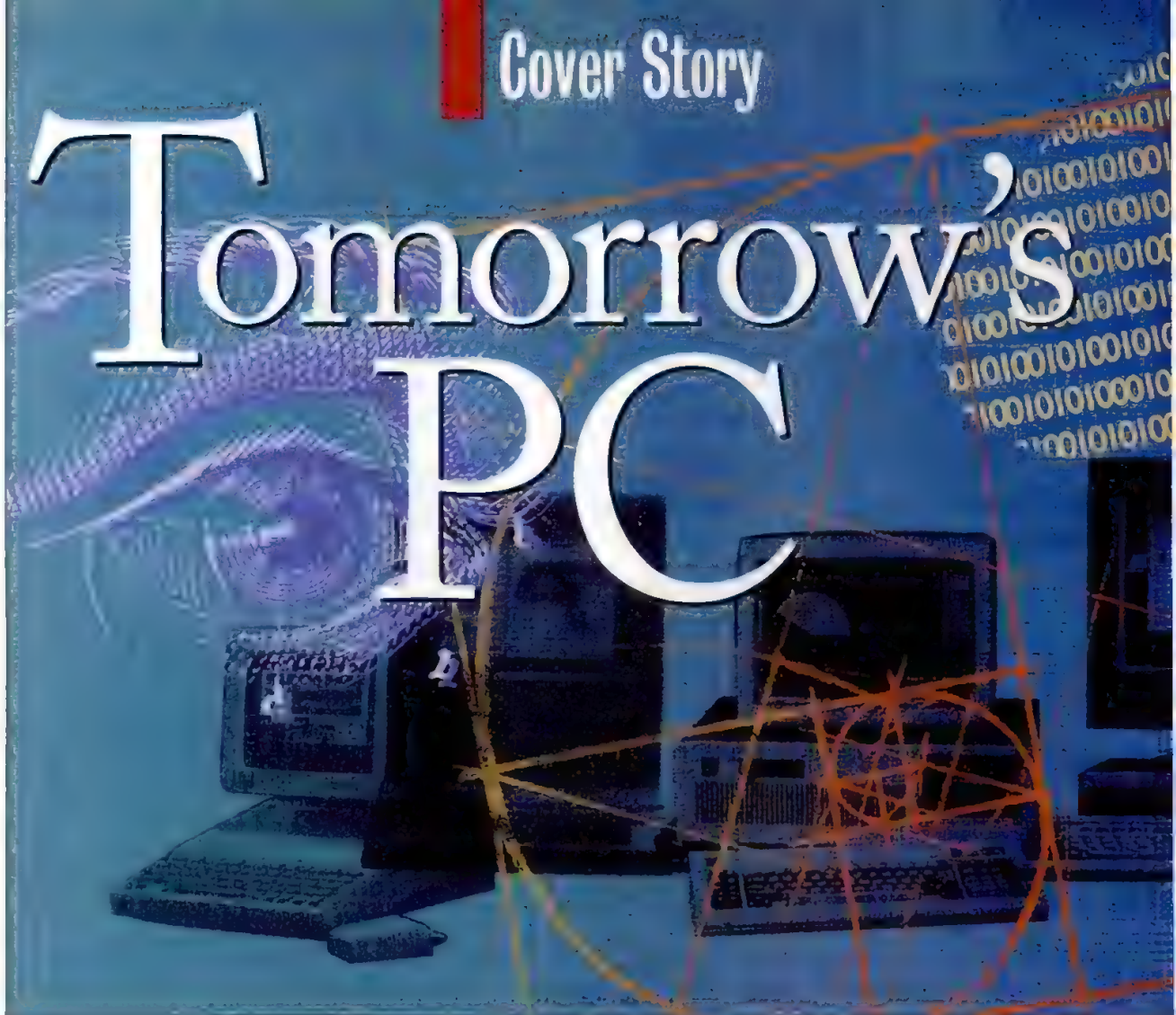
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Tomorrow's PC



What is the PC's future? Will it involve RISC processors or Intel-compatible $x86$ CPUs? *PC Magazine* examines tomorrow's computers and operating systems.

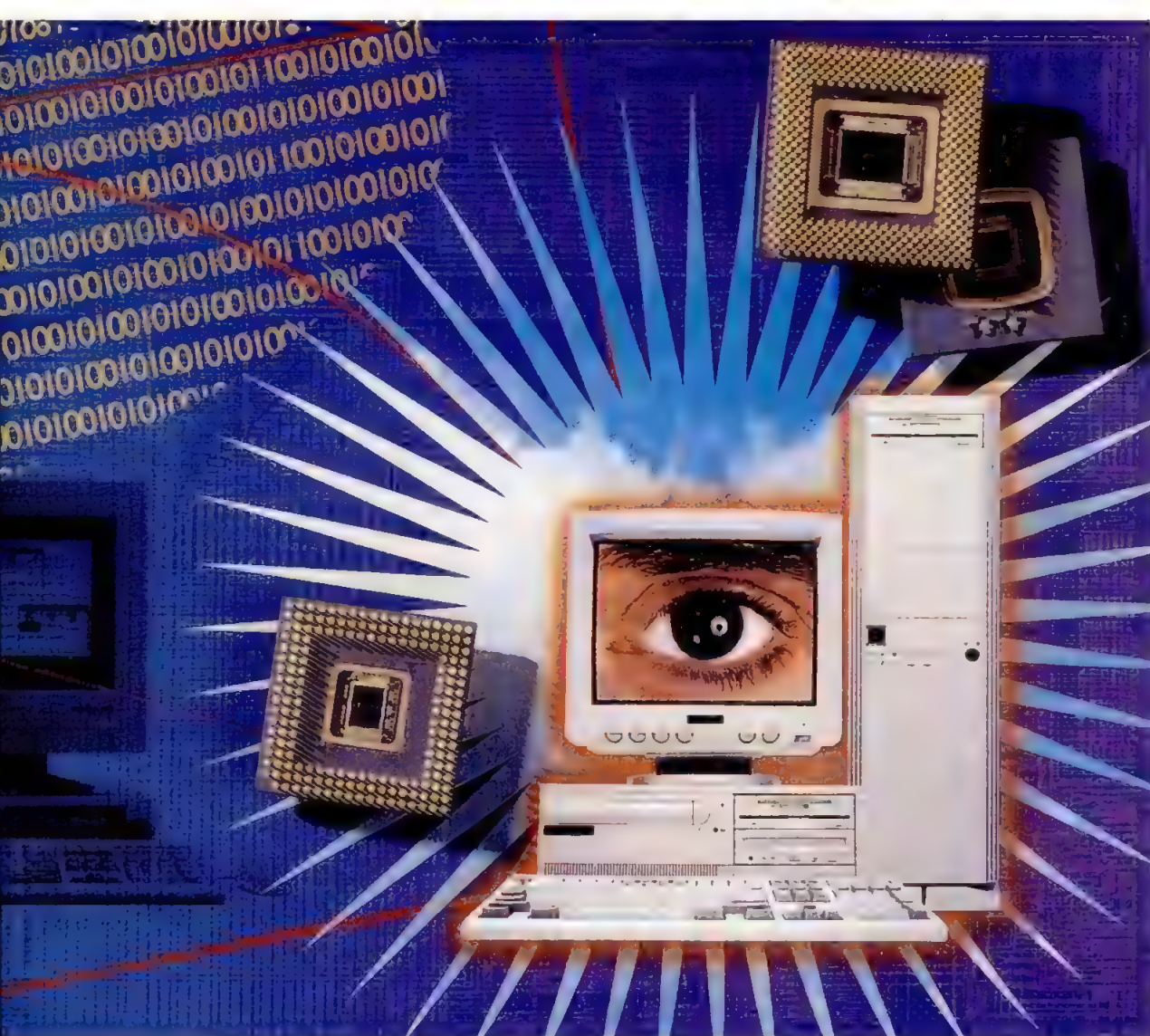
By Michael J. Miller

Most of the time, most of us use personal computers that are based on Intel or Intel-compatible processors. And most of the time, that's what we focus on here at *PC Magazine*. After all, that defines most of what most people call a PC.

But the definition of a PC continues to broaden. Over the past year or so, we've seen more and more architectures offer methods of running applications originally developed for the PC, and more operating systems designed to work across multiple hardware platforms. This trend is certain to continue, and we'll

see many large computer makers offering systems based on multiple architectures and running multiple operating systems. Determining which architectures and environments are appropriate for particular uses and making them all interoperate is a major challenge, especially for large organizations. In this issue, we try to make sense of the growing diversity of platforms and operating environments.

We start by looking at the range of hardware. PC Magazine Labs in New York City, ZD Labs in Foster City, California, and Workstation Labs in Humboldt, Arizona, have spent months looking at all sorts of new machines for this issue. None of the new developments



have attracted as much scrutiny as the PowerPC architecture from Apple, IBM, and Motorola.

Intel has faced competitors before, but rarely has a single new chip generated the kind of excitement surrounding the PowerPC. In "Pentium vs. PowerPC: Battle for the Desktop," we take a close look at the first PowerPC systems and how they stack up against machines based on the latest version of Intel's Pentium.

Of course, the PowerPC is far from being the only new architecture. In the story that follows, "RISC Workstations: Ready for the Desktop?," we look at 14 workstations—6 designed to run Microsoft Windows NT and 8 designed to run variations of Unix—2 of which are Pentium-based PCs. While historically, RISC-based systems have been used for high-end graphics and scientific and engineering applications, they are increasingly being considered for the business desktop.

On the application server side, the considerations and hardware possibilities are even more diverse. Since your PC application can still run on your

desktop, compatibility becomes less of an issue and interoperability becomes paramount. Many organizations have their PCs hooked into Unix-based application servers running large SQL-based databases. In "One Size Does Not Fit All," we look at a wide range of application servers, from machines with familiar Intel-based architectures to others with emerging chips and proprietary systems. The systems range from single-CPU RISC machines all the way to a machine that incorporates six processors.

Even on Intel architectures, the high end of the market continues to search for more powerful environments than the combination of DOS and Windows. In "Life After DOS," we examine such 32-bit operating systems as OS/2, Windows NT, and several variations of Unix.

The definition of a PC is changing as the architecture, the operating environment, and the applications evolve to meet our changing needs. The only thing certain is that we'll see even more changes in the years to come.

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Battle for the Desktop

Will your next desktop computer be powered by an x86 microprocessor or a new-generation RISC CPU? *PC Magazine* looks at the first PowerPC systems to hit the market.

In an industry where three years is a lifetime, the 16-year-old CISC architecture that underlies every x86 processor—from the antediluvian 8086 to the speedy Pentium—is practically a prehistoric artifact. Continual evolutionary improvements and price reductions can't mask the age and complexity of x86 microprocessors, with their large number of pin-out connectors and their elaborate instruction set. For years, industry soothsayers have continued to predict that the balance would soon shift toward RISC processors, which—because they embrace simplicity at a fundamental level—are cheaper and easier to develop and manufacture.

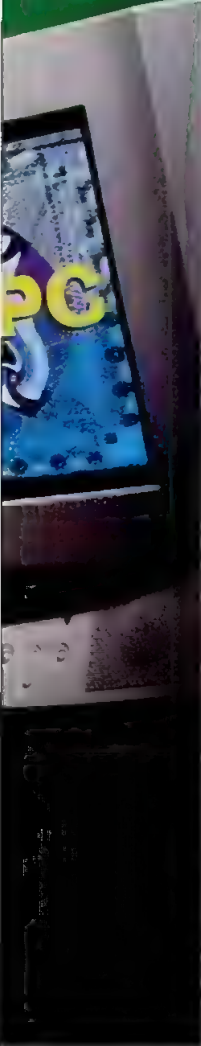
The newest kid on the RISC block, PowerPC has the potential to make the deepest inroads on the desktop. With its high performance and unprecedented industry backing, the PowerPC family could give the Pentium a good fight. Over the next two years, Apple will incorporate PowerPC processors into its entire Macintosh line; according to the market researchers at Dataquest, this could account for 700,000 units in 1994 alone. IBM is already producing PowerPC RS/6000 engineering workstations (as outlined in "RISC Workstations: Ready for the Desktop?"), and in late summer it will unveil machines

that will compete directly with high-end DOS/Windows PCs. Helping spur initial acceptance of PowerPC systems is the fact that they can run most of today's PC and Macintosh software using a variety of emulation techniques. But the question remains: Does the PowerPC family offer enough to cause a sea change in desktop computing?

SEE HOW IT RUNS

To gauge how well PowerPC systems perform, we got our hands on three PowerPC Macintosh systems: a 60-MHz Power Macintosh 6100/60, a 66-MHz Power Macintosh 7100/66, and an 80-MHz Power Macintosh 8100/80, along with a Motorola

By John Clyman



68040-based Macintosh Quadra 840AV for comparison. To see how well the Power Macs stand up to Intel-based systems, we tested a 66-MHz Pentium ALR Evolution V/66 and a 100-MHz Pentium system from Intel. (For more information on the tests and configurations, see "How We Tested.") On the whole, the 100-MHz Pentium outperformed the 80-MHz Power Macintosh when both were running the same native applications, but the Power Mac had the advantage on more engineering-oriented operations that use the PowerPC's extensive floating-point capabilities.

For all the hype about RISC design, the early PowerPCs haven't clearly surpassed the Pentium in terms of performance. Today, in fact, we think the balance favors Intel. But PowerPC deserves a favorable nod for its impressive floating-point capabilities, and Mac users will certainly be pleased with the performance boost

they'll get from native PowerPC apps.

The first PowerPC chip—and the only one available today—is the PowerPC 601, which runs at 60, 66, or 80 MHz. The PowerPC 601, like the Pentium, is a super-scalar CPU; it can execute up to three instructions per clock cycle, although only one of those can be an integer instruction. By most comparative measures, the PowerPC 601 and the Pentium produce roughly equivalent performance at the same clock speed in integer operations, the mainstay of general applications.

The PowerPC 601 contains 2.8 million transistors, or about 300,000 fewer than the Pentium—a difference that is magnified when you consider that the 601 has double

the Pentium's 16K on-board cache. IBM manufactures the 601 on a 0.6-micron, 4-layer-metal process that results in a die of less than 120 square millimeters. By contrast, the first 60- and 66-MHz Pentium processors were manufactured on an 0.8-micron process that produced chips with an area of 294 square millimeters—more than twice the size of the 601 and therefore more expensive to manufacture.

In March, Intel began shipping new Pentium CPUs built on its own 0.6-micron process. The new 90- and 100-MHz Pentium processors run faster and cooler, and challenge one of the key advantages of the soon-to-be-released PowerPC 603: low power consumption. The PowerPC 603 was designed to run on 3.3 volts and to draw only about 2 watts, making it ideal for notebooks and energy-saving desktop PCs. But the new Pentium CPUs run on 3.3 volts and draw about 4 watts, compared with 13 watts for the first-generation chips. We expect to see Pentium-based notebooks by this fall, a full season before mainstream PowerPC 603-based notebooks will be available.

CPU LEAPFROG

We also expect that Intel and the PowerPC consortium will leapfrog each other over the next several years, with the PowerPC family gaining an early edge because of the difficulty in extending the x86 architecture. Already, IBM and Motorola have announced a 100-MHz implementation of the PowerPC 601, scheduled to ship in quantity later this year. Shortly thereafter, the PowerPC 604 will break new ground with its ability to execute up to four instructions—three of them integer instructions—during each clock cycle. That will make it substantially faster than even the 120-, 132-, or 150-MHz Pentiums that will likely be available around the same time.

Then the fun starts, with the arrival of the PowerPC 620. Unlike the previous PowerPCs—and any CPU that Intel has announced—the PowerPC 620 is a true 64-bit processor. The Pentium, by contrast, operates on 32 bits of data at a time, although it connects to a 64-bit external bus. We expect the PowerPC 620 to be available before Intel's Pentium successor, known informally as P6. But given that most software developers are only

today embracing 32-bit code, it's likely to be quite some time before 64-bit programs that can use the PowerPC 620's full power become commonplace.

If PowerPC passes the x86 family in raw performance, will its lead last? Not indefinitely. The balance of power can quickly shift. Intel will continue to develop its CPUs, making them look ever more RISC-like while retaining full backward compatibility. So will Intel's competitors: Both AMD and Cyrix Corp. have previewed processors that maintain x86 compatibility but work around many of the bottlenecks that restrict performance in today's Pentiums. Such processors suggest that today's Pentium is far from the last word in the x86 line. Even looking ahead, we still call it a tie between PowerPC and x86 systems on the CPU level.

More important than the clock speed of a CPU is how fast it actually runs applications. On the whole, the Intel 100-MHz Pentium system surpassed the performance of the 80-MHz Power Macintosh when both were running the same native applications. For instance, the 100-MHz Pentium changed the font in a large Aldus PageMaker file about a second faster than the 80-MHz Power Macintosh; on the same test, a Quadra 840AV—the high end of Apple's 68k-based Macintosh line—took 3 seconds longer to make the font change than the 80-MHz Power Mac.

Comparing the 66-MHz Pentium system with the 66-MHz Power Macintosh, we found that the Pentium was between 15 and 45 percent faster on typical operations like opening files and redrawing screens. In other tests, the 100-MHz Pentium was able to replace a text block in a WordPerfect document in less than four seconds; the 66-MHz Pentium took five seconds; and the 80-MHz Power Macintosh took nearly 13 seconds.

In tasks that emphasized floating-point performance, the Power Macs reigned. For instance, the CMYK conversion in Adobe Photoshop, which changes illustrations from Red-Blue-Green to Cyan-Magenta-Yellow-Black, ran about 50 percent faster on the Power Macintosh 8100/80 than on the Intel 100-MHz Pentium system.

THE BIG PICTURE

You won't be able to run your favorite PC applications unassisted on PowerPC sys-

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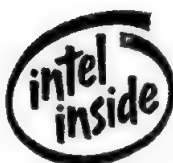
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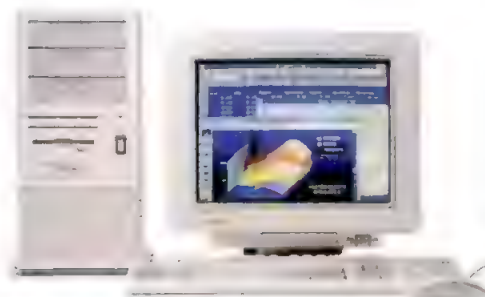
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tems. Chances are, though, that you will be able to support them through a program called an emulator—albeit with a performance penalty that eliminates any speed advantage PowerPC processors might have. Emulators mimic the characteristics of one processor in one system while running on another processor in another system, translating instructions on the fly. Emulators will provide an interim solution for running applications until native programs become available.

The most successful emulation of all is on the Power Macintoshes, which look and feel exactly like 68k-based Macintoshes. The Power Macintoshes run System 7.1.2, a version of System 7 modified to run on PowerPC. The system software and the machines' ROM together provide completely seamless, transparent emulation for 68k-based Macintosh apps. Our testing validated Apple's performance claims: We found that the Power Macs ran today's apps at roughly the speed of a Quadra 700.

That's important, since only a handful of native applications are available for the Power Macintosh today—although well over 100 software developers are committed to bringing out products for the new

Pentium-based PC

Pros

- Runs DOS and Windows and more than 50,000 native applications.
- Available from approximately 200 national system vendors.
- Processor available at speeds of up to 100 MHz.

Power Macintosh

- Retains look and feel of current Mac line; runs System 7.
- Processor available at speeds of up to 80 MHz.
- Runs 68k Mac applications via built-in software emulation.
- Runs many DOS and Windows applications via emulation.
- Offers superior floating-point performance.

Cons

- Can't run Mac applications in native mode
- Uses some peripherals and software that may be hard to configure
- Available only from Apple Computer.
- Runs emulation relatively slowly.
- Requires native software to reach full potential, and few such applications are available today.

machines. The Power Macs can also run DOS and Windows software with SoftWindows from Insignia Solutions (800-848-7677), a \$499 package that's available preloaded on some Power Macintosh configurations.

Don't consider throwing away your PC to run SoftWindows on a Mac just yet; the performance simply isn't good enough, and currently the emulator only mimics a 286, meaning that you can't run enhanced-

mode Windows. But if you need a Mac as your primary computer and also want to run one or two DOS or Windows programs, you should have no problem.

Under SoftWindows, the PowerPC systems were easily outrun by a 486SX/25 system from Hewlett-Packard. An 80-MHz Power Macintosh running SoftWindows acts more like a fast 386—adequate for occasional use, but hardly reason to spend upwards of \$6,000 (a typical street price for a fully configured 80-MHz Power Mac). For instance, a 100-MHz Pentium recalculated a Windows-based Excel spreadsheet in 3 seconds, while the 80-MHz Power Mac in emulation took 43.1 seconds—giving the Pentium a more than tenfold advantage. Even the 486SX/25 PC performed the task in less than half the time of the high-end Power Mac.

WHAT IT COSTS/WHAT YOU GET

Prices for entry-level Power Macintosh systems tend to be slightly higher than for comparably-equipped Pentium machines. However, at the high-end Macintosh prices come close to Pentium PC prices because Apple includes many things that are options on performance PCs, such as SCSI. (See the table "Features and Price: How the Platforms Compare.") What Apple's Power Mac line doesn't include is a basic high-end configuration that is comparable to the sub-\$3,000 Pentium systems from (among others) Austin, Gateway, and Micron.

The Power Macintosh lineup also lacks a PowerPC-based notebook; the company says it is waiting for the low-power Power-

HIGHLIGHTS

Pentium vs. PowerPC

THE BATTLE BETWEEN the PowerPC and the Pentium comes down to the problem of fulfilling needs in both performance and compatibility. Though the first PowerPC Macintoshes can run most Macintosh 68k and Windows applications, they do so through emulation, which saps performance.

PERFORMANCE on general business programs is where the Pentium shines. Systems based on Intel's 100-MHz Pentium were between 15 and 45 percent faster on equivalent native applications than the 80-MHz Power Macintosh.

MEGAHERTZ FOR MEGAHERTZ, the Pentium and the first PowerPC chips are roughly equal in integer performance—the mainstay of most general

business programs. But due to its greater floating-point capabilities, the PowerPC will provide better results for those whose computing style leans toward scientific analysis or graphics.

THE BOUNDARIES BETWEEN RISC and CISC are fading as each design school borrows and adapts the best elements of the other. Still, the Pentium's complexity has its drawbacks: The chip has 300,000 more transistors than the PowerPC 601 and is built on a larger die.

APPLE will be the biggest customer of PowerPCs, at least at first, with an estimated 700,000 needed to fulfill the demand for Power Macintosh systems in 1994. There will be PowerPC PowerBooks as well as PowerPC Newton PDAs.

Features and Price: How the Platforms Compare

	Operating system	CPU	RAM	External cache	Hard disk	Monitor size	VRAM	Price
Power Macintosh 6100/60	System 7.1.2	PowerPC/60	8MB	None	250MB	15-inch	2MB	\$2,909
Power Macintosh 7100/66	System 7.1.2	PowerPC/66	8MB	None	500MB	15-inch	2MB	\$4,469
Power Macintosh 8100/80	System 7.1.2	PowerPC/80	16MB	256K	500MB	15-inch	2MB	\$5,929
ALR Evolution V/66	DOS 6.2, Microsoft Windows 3.1	Pentium/66	16MB	256K	527MB	15-inch	2MB	\$5,388
RISC System/6000 POWERstation 25T	IBM AIX 3.2.5 (Unix), AIXwindows 2D	PowerPC/66	16MB	None	540MB	17-inch	2MB	\$9,395

PC 603 before building one. There's a good chance there'll eventually be a PowerPC-based Newton PDA as well.

The picture will get even more interesting if Mac software developers use the PowerPC's speed to endow their software with capabilities not available anywhere else. That appears likely, given operating system features such as 3-D graphics support, integrated speech input and output, and active user interfaces that coach you through tasks. The first taste of these enhancements will come this summer, when Apple releases System 7.5 for both 68k and PowerPC-based Macs. System 7.5 will include QuickDraw enhancements, a scriptable Finder, drag-and-drop capabilities, and integrated file-synchronization utilities.

IBM's goal for PowerPC on the desktop is part of a two-pronged assault. IBM's PC Company, the largest seller of x86 computers, will stick with what works for them: 486s and Pentium PCs. IBM's newly-formed Power Personal Systems division will carry the PowerPC banner, though they will not have a system ready for market until sometime late this summer.

The features and capabilities of these Power Personal PCs are coming into focus

with the PowerPC Reference Platform (PReP) specification. PReP details the hardware, operating-system, and software elements necessary to build PowerPC-based systems that meet certain compatibility goals. PReP is intended to be a royalty-free blueprint for tomorrow's desktop PC. These machines will run 32-bit operating systems and will resemble today's high-end desktop systems with lots of memory, CD-ROM drives, stereo audio support, and PCI/PCMCIA expansion buses. At the time of this writing, Canon—which plans to make PowerPC portables—was the only manufacturer besides IBM that had publicly committed to selling PReP-compliant systems in the U.S.

The Power Personal Systems group plans to emphasize what it calls human-centered computing—focusing on an appropriately vague concept of “natural” input techniques such as speech recognition and endowing systems with intelligent agents that learn your work habits to help automate tasks. The high-end Macintosh is already there with voice-activated navigation but its accuracy is spotty. During a recent demonstration, however, an Apple engineer had trouble getting his system to

listen to his pleas to open a file.

Although PReP supports a variety of 32-bit operating systems, it's not yet clear which one mainstream users will find appealing. Two of the most likely candidates are Windows NT, which is being ported to run on PowerPC, and Workplace OS, an IBM-developed operating system that can assume different personalities (including one for OS/2). But Windows NT, despite its apparent similarity to Windows 3.1, is positioned as an operating system for servers and workstations more than for individual desktop machines; and Workplace OS (OS/2 for PowerPC), which will ship later this year, may end up suffering from lack of developer support.

WHAT OPERATING SYSTEM?

The operating system that most observers believe will dominate a year from now is Chicago, the next version of Windows, which is closely tied to the x86 architecture and won't be available at all on PowerPC systems, though there will be some crossover of applications between Chicago and NT. There is an outside chance that Apple's System 7, or some future update, could also become an option on PReP systems; Apple has been talking to major PC vendors about licensing the Macintosh OS. No takers so far.

That means that, just like the Macintoshes, PowerPC machines will run PC software only through emulation for quite some time. That emulation is likely to be integrated into the operating system (as it is now in the versions of Windows NT that ship for the DEC Alpha and MIPS R4000 platforms), but it will still be burdened by poor performance. The bottom line is that if Windows is your mainstay, a PowerPC future is still distant.

It's possible that IBM will try to ease the transition to the PowerPC line by developing a CPU that combines both

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Benchmark Tests: Pentium vs. PowerPC

In terms of general business applications, the Pentium PC is the platform of choice. When floating-point performance is needed, a PowerPC machine offers clear advantages.

What The Numbers Mean

NATIVE-MODE APPLICATIONS TESTS

Some of the native applications were still not final shipping products at the time of our tests. That may explain why certain functions within some of the applications still appear to be emulated based on their performance versus the Macintosh Quadra 840AV. Examples include the ClarisWorks database sort and Fractal Design Painter's glass distortion function.

The 100-MHz Pentium system is superior on almost all application functions that do not require floating-point operations, placing it at the head of the pack for general business performance. For example, compared with the Power Macintosh 8100/80, the Pentium systems were considerably faster at performing replace and print functions in WordPerfect but lagged on the scroll function. Since the scroll function stresses video-bus bandwidth, these results imply that Power Mac video subsystems are better than PCI local-bus boards for transmitting large volumes of raw graphical bitstreams. In fact, the Power Mac's scroll function results improve as processor speed increases, but the 100-MHz Pentium delivers performance similar to that of the 66-MHz ALR Evolution V.

The PowerPC systems were noticeably superior in floating-point-intensive CPU functions. For instance, the Power Mac completed Fractal Design Painter's lighting effect function in less than half the time it took the Quadra 840AV. The 100-MHz Pentium system took about 30 percent longer than the Power Mac on the same test. On Adobe Photoshop's CMYK conversion, and unsharp mask functions, the same trend held.

EMULATION TESTS

Apple built the Motorola 68k emulator to allow its Power Macintoshes to run virtually all 68k-based Macintosh applications; Insignia Solutions provides the SoftWindows emulator that allows popular x86-based Windows applications to run on the Power Macs. Because SoftWindows is currently based on the 286 version of Windows, many applications requiring 386 Windows enhanced-mode functionality won't run.

It is clear from our test results that the Power Mac's 68k emulation is superior to SoftWindows' x86 performance, but both are much slower than native execution of Windows on the Pentium systems. Apple claims that the Power Mac has 68k emulation comparable in speed to a Quadra 700 on

Macintosh 68k software and has SoftWindows performance similar to that of a 486SX/25-based PC.

Our test results show that the Power Macintosh 8100/80 was on a par with the Quadra 700 in typical operations like font changing (Aldus PageMaker), file opening (Adobe Photoshop), and printing (Microsoft Word and Claris's FileMaker Pro). But in terms of CPU-intensive tasks that stress both integer and floating-point functions, the Power Mac running 68k code did not come close to the Quadra 700 in performance. The Power Mac 8100/80 took more than twice as long as the Quadra 700 to complete an Excel recalculation.

The PowerMac's 68k emulation is burdened with floating-point operations implemented as integer operations using SANE code, which results in reduced performance on the Adobe Photoshop floating-point-intensive operations. The ALR Evolution V/66 Pentium unit was three times as fast as the Power Mac in these functions, and the 100-MHz Intel Pentium test machine was four to six times as fast, depending upon the operation.

The Pentium systems running Windows natively easily beat the emulated Power Mac results on all reported tests. Running SoftWindows, the Power Mac couldn't keep up with the 486SX/25-based HP unit on the CPU-, memory-, or video-intensive operations in Aldus PageMaker, Microsoft Word, Microsoft Excel, and Claris's FileMaker Pro. Digital's Alpha system running Windows 3.1 applications in emulation under Windows NT produced results that were comparable with the Macintosh systems on the scroll test in Microsoft Word but took as much as 20 times as long as the Pentium systems to complete other tests.

COMPONENT AND TUNING TESTS

The use of an external cache significantly improved application performance across a wide range of functions. Proportional improvements in performance were seen in both 68k emulation and native modes on the PowerMac 7100/66. External cache variations had little effect on the disk-intensive Adobe Photoshop File Open test, as expected.

Depending on the effectiveness and size of software and hardware caches installed, and on application disk usage characteristics, a faster disk drive can noticeably affect performance on some disk-bound processes. To our surprise, the 7100/66 (in the no-external-cache configuration), using a Maxtor SCSI-2 drive, outperformed the 8100/80 with its Seagate drive in the Adobe Photoshop File Open test and further distanced itself from the other two tested 7100/66 configurations that used the Quantum drive. For large sequential read operations, disk caches are relatively useless, and drive/host adapter speed is important.

Video differences appeared between the Power Mac's AV, HPV, and on-board video systems and those of the Pentium. These results prove that all-around performance relies on much more than just the CPU.—*Analysis written by Jeff Davis and Nick Stam*

PowerPC and x86 cores. The result would be a processor that borrows the best of both worlds—running existing applications without a severe performance penalty, and then offering the punch of PowerPC as soon as software is available. Since IBM has rights to Intel processors through the 486, there's nothing that would prevent such a hybrid, although it would be a large and there-

fore expensive CPU to manufacture.

This strategy could backfire by removing the incentive for software developers to port their products in the first place. Nevertheless, a chip that truly melds RISC and CISC architectures is an intriguing possibility. IBM won't comment, but it also won't rule out the possibility.

For now, give x86 PC systems two points over the PReP-based machines

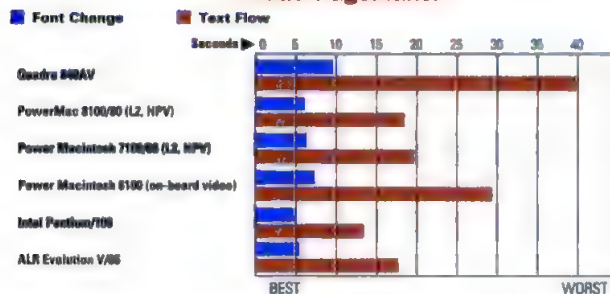
both for running the preeminent OS and for being available from scores of national system vendors at low prices.

THE FUTURE OF THE PC

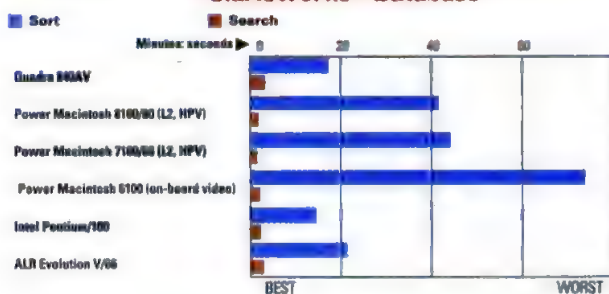
At the system level, the Power Macintoshes look great: They've got the same appealing interface as always, and native software development appears to be well underway. Their performance doesn't

NATIVE-MODE APPLICATIONS TESTS

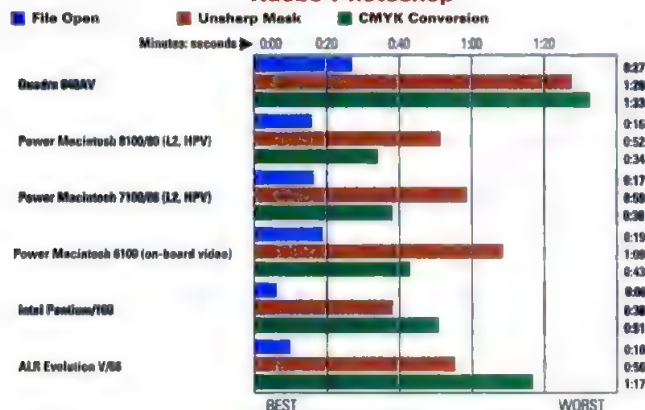
Aldus PageMaker



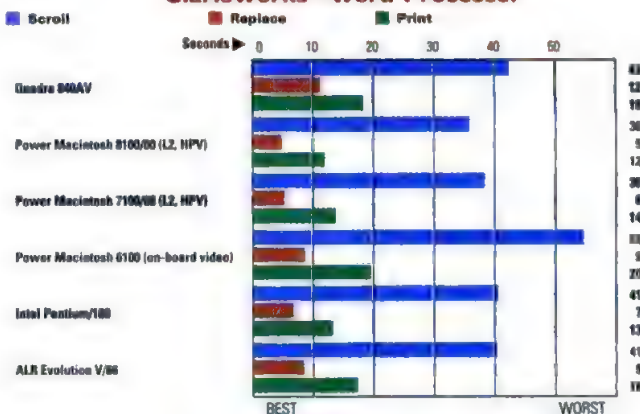
ClarisWorks—Database



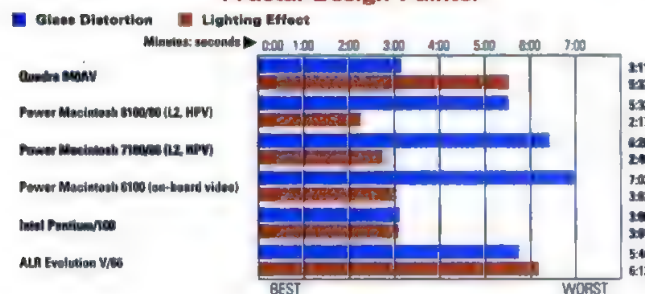
Adobe Photoshop



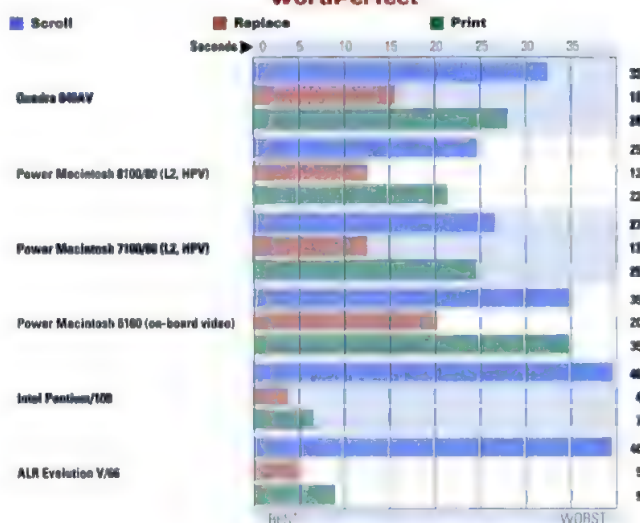
ClarisWorks—Word Processor



Fractal Design Painter



WordPerfect



Aldus FreeHand



L2—Level 2 cache installed. HPV—Power Macintosh high-performance video card installed.

leave the Pentium in the dust, though—except in floating-point-intensive operations, where the PowerPC systems have a clear lead. And, of course, the Power Macs run many DOS and Windows applications at a passable speed.

If you're already a Mac user, the answer is simple: Stick with it. If you're not, there's little new reason to give up your PC unless you're doing floating-

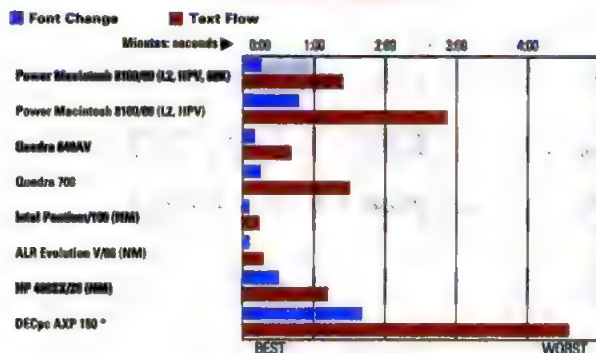
point-intensive graphics work.

The PReP-compliant systems look far less compelling and will be worth considering only if and when 32-bit applications for Chicago start getting ported to Windows NT on the PowerPC platform, which is at least 12 to 24 months away. Even then, the PReP systems will need to provide better price and performance than you can get from x86-system vendors today.

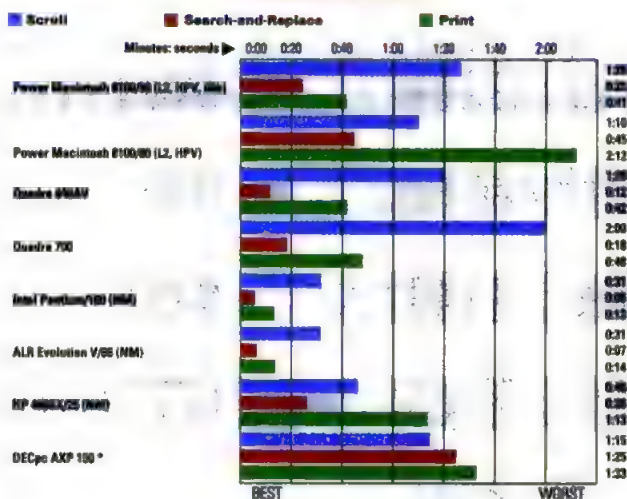
Dinosaurs or not, members of the x86 family still pack a lot of punch. Pentium-based PCs look awfully good considering their heritage. If you're a business user running typical DOS and Windows applications and looking for the best price and performance you can find, the platform of the future is likely to remain the same one that's sitting on your desk today.

EMULATION TESTS

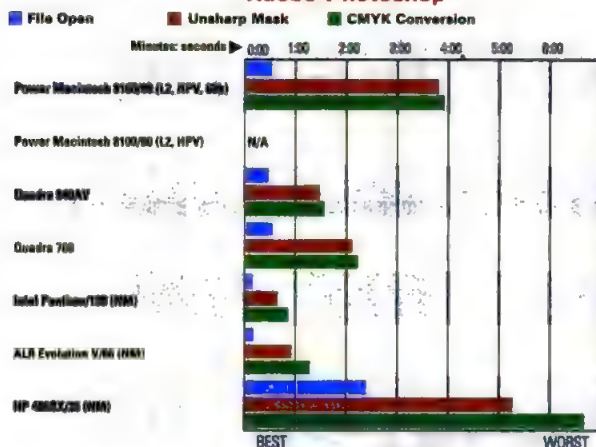
Aldus PageMaker



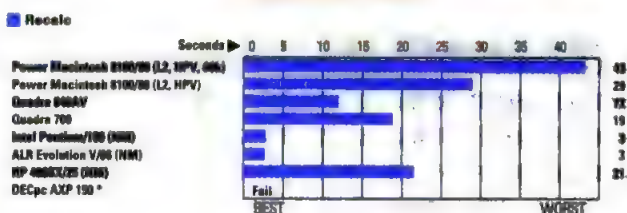
Microsoft Word



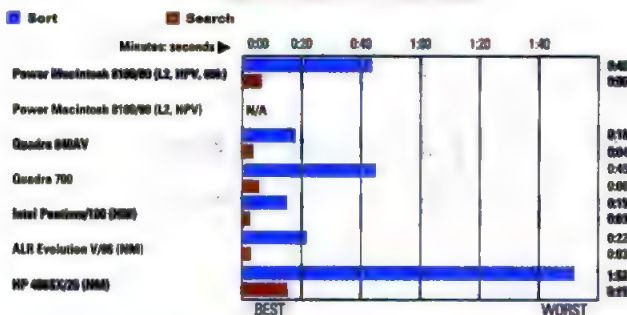
Adobe Photoshop



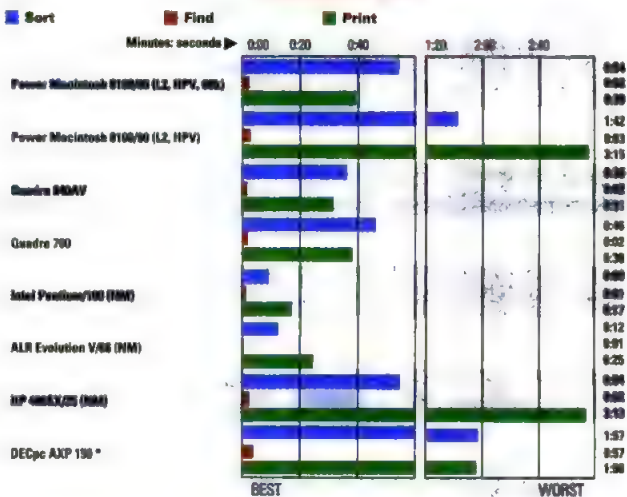
Microsoft Excel



ClarisWorks—Database



FileMaker Pro



L2—Level 2 cache installed. HPV—Power Macintosh high-performance video card installed. 68K—68k emulation. NM—Tested in native mode. * Reported for comparison. Fail—This unit did not complete the calculations accurately.

How We Tested/System Configuration

NATIVE-MODE APPLICATION MODE TESTS

The goal of the native mode applications tests is to compare the speed of applications compiled specifically for each target platform. Native applications are available for the older 68k-based Macintoshes, x86-based PCs, and now the PowerPC-based Macintosh systems. Native applications provide the best performance on a given platform. For example, a Windows application will perform better under its native Windows 3.1 environment than it would under software that only emulates the Windows environment.

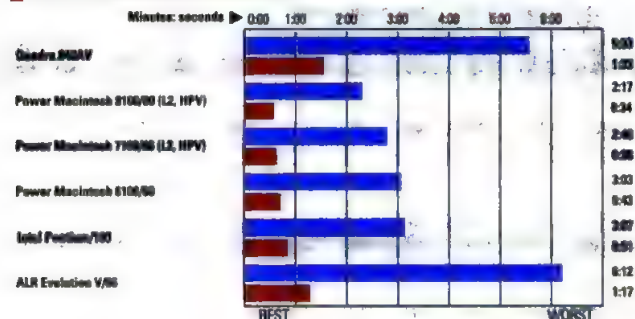
For comparative purposes, we selected PowerMac 6100/60 (60-MHz PowerPC 601), 7100/66 (66-MHz PowerPC 601), and 8100/80 (80-MHz PowerPC 601) systems, along with a Pentium unit from ALR running at 66 MHz, as well as an Intel developmental system running at 100 MHz. We also included a 40-MHz 68040-based Quadra 840AV, the performance leader of the 68k-based Macintosh family.

The PowerMac 6100/60 includes 16MB of RAM, a Quantum 270LPS SCSI-2 drive, on-board video, and no external (L2) processor cache (L2 cache is an optional feature not included in the basic configuration). The 7100/66 includes 16MB RAM, a Quantum 540S SCSI-2 drive, and a high-performance video (HPV)

COMPONENT AND TUNING TESTS

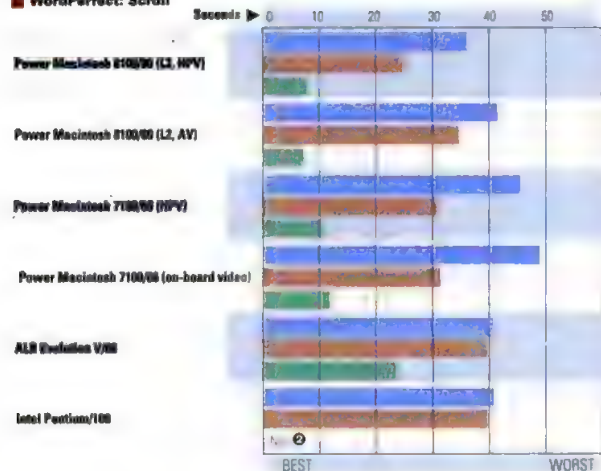
Floating-Point Performance

- Fractal Design Painter: Lighting Effect
■ Adobe Photoshop: CMYK Conversion



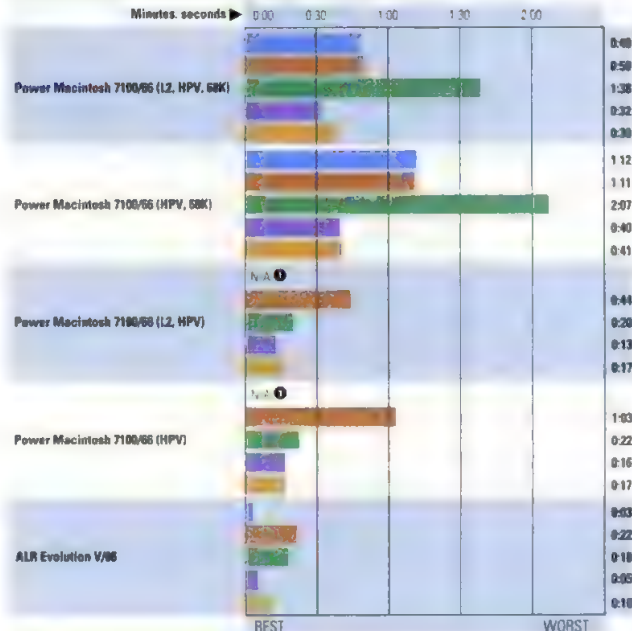
Video Subsystem

- ClarisWorks—Word Processor: Scroll
■ Aldus FreeHand: Preview
■ WordPerfect: Scroll



External Cache Performance Effects

- Microsoft Excel: Recalc
■ Aldus PageMaker: Text Flow
■ Adobe Photoshop: File Open
■ ClarisWorks—Database: Sort
■ WordPerfect: Replace



Disk Subsystem

- Adobe Photoshop: File Open



L2—Level 2 cache installed; HPV—Power Macintosh high-performance video card installed; AV—Apple Macintosh video; 68k—68k emulation; N/A—Not applicable; A native PowerPC version of Excel was not available for this product at test time; N/A—Not applicable; Intel Pentium/100 results are not available for this test.

Processor Direct Slot (PDS) local-bus video card with 2MB of VRAM. We tested the 7100/66 with and without the optional 256K L2 cache. The 8100/80 had 24MB of RAM, a Seagate 1GB SCSI-II drive, and 256K of L2 cache.

The 100-MHz Intel Pentium system had 64K of RAM, a PCI local bus, 256K L2 cache, a Seagate 1.1GB SCSI-2 drive with an NCR SCSI-PCI host adapter, a Matrox MGA-II PCI video board, and Windows for Workgroups 3.11.

The ALR Evolution V/66 Pentium system included 39MB of RAM, 256K L2 cache, a PCI local bus, Matrox MGA-II PCI video, a Tekram 4MB caching disk controller, a Conner CP30544 IDE drive, and Windows 3.1. Both Mac and PC systems were tested at 640-by-480 with 256 colors. The difference in system memory should not affect performance, since only one application was run at a time.

EMULATION TESTS

The emulation tests are designed to help us understand the performance impact of running 68k-based and 80x86-based applications on the PowerPC. We focus our emulation tests on the same PowerMac 8100/80, Quadra 840AV, and Pentium systems that were used for the native-mode tests. To this lineup, however, we also added a Quadra 700, a Hewlett-Packard 486SX/25 Vectra PC, and a 150-MHz Alpha-based Digital system to

round out our comparison.

The Pentium, 486SX/25, and Quadra systems allow direct comparison to native-mode execution. The Quadra 700 uses a 25-MHz Motorola 68040 CPU and has 20MB of RAM and a Seagate 1GB SCSI-2 drive. The HP Vectra 486SX/25 has 9MB of RAM, an HP motherboard video circuit, and a 120MB IDE drive.

Digital's DECpc AXP 150 system has 32MB RAM, a Compaq QVision card, and a DEC 400MB SCSI-2 drive, and runs Windows NT 3.1. Testing is similar to the native-mode application testing, except that each PowerPC-based system runs the applications in emulation mode. On each test, a specific series of operations are performed and timed.

COMPONENT AND TUNING TESTS

Using many of the same system configurations that are described for the native-mode and emulation tests—with a few more variations—we set out to show the effects of different subsystem components on application performance.

In our floating-point chart we highlight the PowerPC chip's capabilities versus the Pentium and also demonstrate the significant improvement over the older 68040 chip in the 840AV. We also look at the effect of video and external cache.

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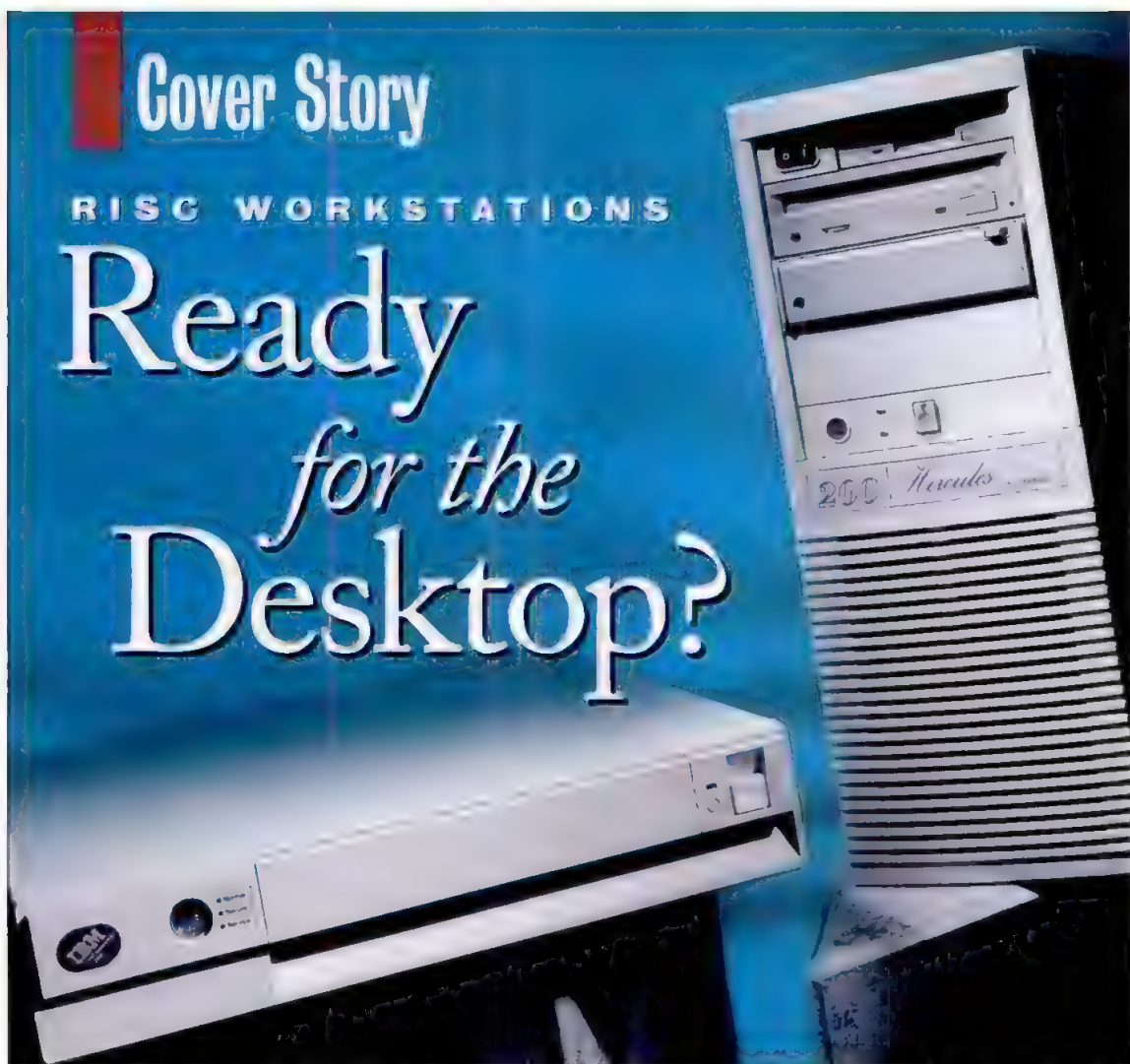
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Cover Story

RISC WORKSTATIONS

Ready for the Desktop?

PC Magazine takes a look at whether the worlds of RISC workstations and PCs are converging.

By Jim Seymour

We know: You're tempted. After all, who wouldn't be seduced by stories about 100-MHz and 200-MHz RISC chips? You hear talk about RISC being the future of desktop computing. You see newspaper stories about hotshot traders on Wall Street relying on their RISC machines to move millions of dollars. You watch in amazement as the ballroom scene in *Beauty and the Beast* swirls by, knowing that the impossibly difficult animation was done on a RISC workstation.

And you wonder: Is it time? Time to bail out on that pedestrian Intel-based box on your

desk and finally move up to what the real computer jocks keep on their desks: RISC workstations. We're tempted, too. And we wonder.

For years, the answer for the general computing public has been simple enough: Not yet. Not yet, because those workstations cost too much, they ran

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only Unix, and there just weren't enough mainstream applications available—or if there were, they were never a match for the hot DOS and Windows programs.

But things have gotten complicated since we last took up the RISC question ("The New PCs," June 15, 1993). First, RISC workstation prices have fallen 50 percent and more over the past two years—to a level where many are competitive with the prices of high-end Intel-based x86 boxes. Second, while general applications running under any of the various flavors of Unix are still thin on the ground, they do exist, and many of them have familiar names: CorelDRAW, Lotus 1-2-3, WordPerfect, AutoCAD, and others. The problem is that few of these applications run under all varieties of Unix, and those that do cover most of the bases are older versions of the software.

Then there's Microsoft Windows NT. Microsoft's advanced operating system runs on important RISC architectures such as MIPS' R4000 family or Digital Equipment Corp.'s Alpha series—and soon, Hewlett-Packard's PA-RISC chips and the PowerPC. Now, at least in theory, you can have your RISC and eat it too, so to speak. You don't have to confine yourself to the world of Unix applications, so you don't need to tackle Unix's near-ver-



EDITORS' CHOICE

• IBM RISC System/6000 POWERstation 25T

The phrase "East is East, and West is West, and never the twain shall meet" goes a long way towards explaining the polarization present in desktop computing. PCs offer the flexibility to run thousands of diverse applications, while workstations run very specialized programs

but run them well. A high-end PC can't match the processing ability of a RISC workstation, but none of the workstations we looked at can touch a PC in ease of setup and use.

Within the Unix and Windows NT workstation worlds, all the systems we tested had positive attributes:

- The three Sun SPARC-powered Unix workstations were finely tuned for excellent results in AutoCAD.

- Carrera's Hercules 200 NT system stood out under floating-point-intensive applications like Pro Engineer.

- Silicon Graphics' Unix-based Indy impressed in terms of graphics capability.

tical learning curve and the grief of setting up and working under Unix.

Is considering purchasing a RISC workstation finally a no-brainer move? The answer is still . . . Not Yet.

WHAT WE REVIEWED

We rounded up 11 of the most popular RISC workstations and divided them into two test groups, based on operating system. Those that ran Unix include the DEC 3000 Model 300X AXP Work-

station, Hewlett-Packard's HP 9000 Model 712/80i, IBM's RISC System/6000 POWERstation 25T, the Silicon Graphics Indy, and three systems that use Sun's SPARC architecture: the two-processor Integrax SWS10/512 50MHz SPARCstation 10, Sun's two-processor SPARCstation 20 Model 502, and Tatung's Super COMPstation 10 Model 51. The group of units that ran Microsoft Windows NT includes Carrera's Hercules 200, the AcerFormula 4400, the DeskStation Tyne v4633x, and the NeTpower NeTstation 300. (For a complete rundown of the CPUs involved, see the sidebar "How the Chips Stack Up.")

To place these systems in context, we also included two well-regarded Pentium PCs: the Dell OmniPlex 566 and ALR Evolution V/60, each of which received an Editors' Choice award in an earlier story. Both units ran the x86 version of Windows NT; the ALR Evolution ran under UnixWare and SCO Unix as well. And because Digital Equipment Corp. was in the process of revamping its AXP line of Alpha-based NT workstations, we tested a 150-MHz NT system for comparison only—the DECpc AXP 150. To facilitate the comparison of same-CPU systems, the performance results and reviews are arranged in alphabetical order according to the processor manufacturer.

The minimum hardware requirements for systems included in this roundup were

HIGHLIGHTS

RISC Workstations

IF ULTRA-FAST CPUs impress you, you may have a RISC workstation in your future. But be warned: Compatibility with the gargantuan library of DOS and Windows applications can be had only through emulation software that saps much of a system's power.

WORKSTATIONS ARE workstations and desktop PCs are desktop PCs. Though each type of system has its own audience and adherents, desktop PCs will continue to be the systems of choice for most users.

THE PREDOMINANT OPERATING system of PCs and workstations have

their individual drawbacks. Unix remains hard to learn, Windows NT is still in its infancy, and Windows 3.1 lacks the power and flexibility of a workstation OS.

SAME NAME BUT NOT SAME performance can be expected when you cross the line between DOS/Windows applications and workstation applications. PC DOS/Windows applications boast a larger audience, so the software publishers can expend extra efforts at optimization; Unix and Windows NT applications are few, and they are rarely fully optimized.

- The DeskStation Tyne v4633x, the AcerFormula 4400, and the NeTpower NeTstation 300—powered by MIPS CPUs—all ran NT well.

- Hewlett-Packard's HP 9000 Model 712/80i Unix system did well on applications like FrameMaker and Pro Engineer.

- Digital's DEC 3000 Model 300 AXP, powered by Digital's 200-MHz Alpha CPU, showed its processor prowess on the Khormstone and Dhrystone tests.

- The Pentium systems—ALR and Dell in NT and ALR in Unix—provide the integer capability to run head-to-head with the best workstations but can't keep up on floating-point tasks.

The IBM RISC System/6000 POWERstation 25T, however, which stood

out as the most versatile of the systems we looked at, deserves an Editors' Choice. The \$15,525 RS/6000 is the first workstation to use the 66-MHz PowerPC 601 processor. Systems of higher and lower capability and price will augment the line over the next few years. The chip itself provides a good balance between integer math and floating-point operations. Clearly focused on graphics, the RS/6000 led on the Xmark and Graphstone tests by 30 percent. It had average numbers in each application test, where the results were closely spaced.

Because of the lack of software we felt that none of the NT systems were on a par with the Unix systems.

suitably demanding: 32MB of system memory, a 400MB hard disk, a 15-inch display, accelerated video adapters supporting at least 800-by-600 resolution, a CD-ROM drive, and a keyboard and mouse. All this hardware had to be available for a system cost of under \$22,000.

We had two questions on our minds while testing these systems. First, can a RISC workstation offer the ease of setup and range of software we've taken for granted in the PCs we use every day? And second, which systems best fulfill the role of a good all-around engineering workstation?

TRICKY TESTING

This kind of cross-platform testing is always complicated by the lack of truly equivalent benchmark tests. For example, instead of using our familiar DOS and Windows benchmark tests, we had to use a matrix of seven tests that measure performance in different areas. But all tests were not available or able to run on all systems. The SPECint92 and SPECfp92 scores, for instance, provide an excellent indication of a system's computational ability but run only on Unix workstations at this time. We also ran several cross-platform applications—CorelDRAW, FrameMaker, PV-Wave, Picture Publisher, Pro Engineer, and AutoCAD; but again, not all the systems ran all the software.

Be warned: Just because applications

have the same name and are packaged in a similar box, this hardly means that they are the same or that their publishers have devoted the same effort to fine-tuning each release for its intended platform. Though several prominent software vendors in the DOS/Windows world have Unix releases of some of their products, the Unix versions rarely receive as much care in terms of performance-tuning as the much more profitable DOS and Windows versions.

Even within the Unix world, a given application is rarely available to all users. For example, WordPerfect runs under SCO Unix, but not for the DEC system, and only in an older version for the Silicon Graphics Indy. The curious result is that a stellar application first created in the Unix-dominated minicomputer world cannot run under all the flavors of Unix. As our tests show, performance varies from machine to machine among the various Unix versions and Windows NT.

BIGGER EQUALS BETTER?

In many ways, RISC systems and the x86 CISC systems we're more accustomed to using are very similar. With the exception of chips in HP's PA-RISC family, both kinds of CPUs rely on both internal caches and external caches to eliminate the data bottleneck caused by the fact that the CPU is operating much more quickly than the system bus. And the two chip-design philosophies have borrowed freely from

one another; there are many RISC-like features, such as pipelining, in current CISC designs. The other subsystems are also similar, though workstations typically demand more resources in every category. For instance, workstations historically have pushed the envelope of graphics speed and quality; they also have sported large color monitors in addition to high-performance, high-resolution display adapters—and as far back as a decade ago, when most PC owners were considering IBM's then-new color EGA video standard that displayed 16 colors at 640-by-350.

Because workstations routinely surrender 300MB or more of their hard disks to the Unix operating system, hard disks with capacities of a half-gigabyte or more are most common. SCSI-2 is the dominant hard disk interface, and memory demands are heavy, with 16MB a bare minimum of RAM for running current versions of Unix; 32MB or more is much more common. Finally, Unix workstations are almost always networked, so built-in Ethernet connections are the norm. Unix itself has tried to put on a prettier, friendlier face in recent years; Sun's version of Unix, Solaris, has probably gone furthest in developing an attractive GUI that will feel familiar to any Windows user.

But the biggest difference between today's RISC workstations and today's high-end PCs is the possibility that a RISC workstation will have two (or more) CPUs installed. Symmetrical Multiprocessing, or SMP, is a powerful and highly cost-effective way to increase system performance. Engineers estimate that the best-designed scalable RISC chips add about 80 percent more raw processing power with each chip, at a total system price increase of only about 15 percent. Multiprocessing is trickling down from the server level of engineering and just coming to x86 machines—mainly on Windows NT systems. It is already a fixture in the Unix/RISC world. Two of our test machines—the Integrix SWS10/512 and Sun's SPARCstation—had two RISC processors each.

A THREAT TO THE DESKTOP PC?

The bottom line is that we don't see RISC workstations as threats to midrange and entry-level PCs. Clearly, the lure of the

RISC world is speed, speed, and more speed—which translates into competition for high-end x86 PCs. In designing, building, benchmarking, buying, and using computers, it's important to remember that there is speed, and then there is *speed*. The biggest advantage of RISC workstations over CISC-based x86 designs has always been in floating-point math performance rather than in integer-math calculations. Since few DOS/Windows applications rely on floating-point math, and current Pentium designs offer parity in terms of integer operations, the performance advantage of RISC machines' floating-point unit (FPU) doesn't deliver much improvement on general business applications.

Does that matter to you? If you use technical, graphical, or scientific software that is highly dependent on FPU operations, Pentiums still may not be fast enough: You can get substantially faster performance from many RISC workstations for just slightly more than what you'd pay for an all-out 100-MHz Pentium PC.

Chances are that if you need what a RISC machine does best you probably already have one. The world of Unix/RISC workstations is built around specialized software. And RISC users have plenty of incentive to learn Unix's esoterica, to cope with the relatively difficult setup of Unix/RISC machines, and to pay the incremental cost of a Unix/RISC box over a high-end x86-DOS/Windows machine.

Conversely, if you need what an x86

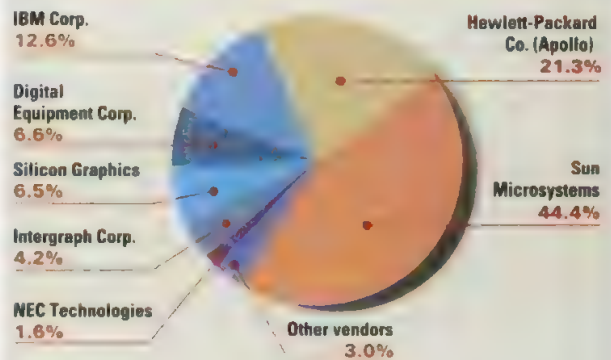
PC does best you probably already have one. There are simply no Unix analogues to such high-performance Windows software as Quattro Pro or Excel. The PC business, at whatever processor-power level, has been built around the idea of ever-faster horizontal applications.

Certainly, Windows NT may change this. With the availability this summer of NT—code-named Daytona—NT will shake off some of its first-release lethargy and begin to attract speedy NT-specific applications. Some of those will be NT ports of scientific and technical applications that are now successful in the Unix/RISC world, but many more are likely to be rewrites of existing Windows business applications.

EMULATION: SOFT OR HARD?

Since the majority of computer users want access to Windows apps, makers of Unix/RISC workstations have tried to bolster their push into the mainstream marketplace by fostering the development of two software-based emulation schemes—Sun's Wabi and Insignia Solutions' SoftWindows—to allow some Win-

The RISC Workstation Market



Source: Computer Intelligence InfoCorp

Percentages are based on the 242,477 units that were rented, leased, or bought in 1993. Sun Microsystems boasts a market share that is more than double that of Hewlett-Packard—its closest competitor.

dows 3.1 applications to run under Unix. But both extract a price. Wabi supports just 13 Windows 3.1 applications and runs them slowly when compared with native Windows. Far from a stable product, Wabi gave us a lot of trouble on our tests, and we remain skeptical about its general usefulness. SoftWindows, though at the time of our testing still in beta form, installed and performed much more reliably—but still ran Windows apps very slowly.

As our testing shows, running emulation reduces the performance of an expensive RISC workstation to that of a sub-\$1,000 486SX/25 PC—if that. As with the dog who sang, the most remarkable thing about both Wabi and

Suitability to Task: RISC Workstations

These 14 workstations—6 running Windows NT and 8 running Unix—offered varying levels of performance in all Suitability to Task categories.

The **Computational ability** score indicates each system's CPU performance. This score is based on results of the Stanford test suite, which measures each system's multithreading ability by running up to 16 concurrent processes, the single-precision and double-precision Whetstone tests, which simulate floating-point programs; and the Dhrystone, a CPU-intensive test that simulates an applications development environment by using integer-based calculations.

When rating Unix-based workstations, we also take into account the results of our SPECint92 and

SPECfp92 tests, which are standardized tests of a system's processor

Expandability refers to a system's potential for growth. Considerations include the maximum number of processors supported, the maximum amount of external cache installable, hard disk options, maximum amount of RAM installable, available drive bays and bus slots, number of ports, power-supply wattage, and the number of power connectors.

The Engineering/scientific/CAD

score reflects a system's ability to run CAD/visualization packages. This score is based on the results of applications tests using Pro Engineer and PV-Wave. When rating Unix-based systems, we also

take into account each workstation's performance in AutoCAD

A good **Graphics/publishing** score reflects more than just a good graphics subsystem; good floating-point-unit and hard disk performance are also key.

SUITABILITY TO TASK	
Computational ability	EXCELLENT
Expandability	GOOD
Engineering/scientific/CAD	FAIR
Graphics/publishing	POOR

We consider the results of the Graphstone—a graphical benchmark test—and the Khonerstone, which measures each system's graphics, hard disk, and CPU performance in an application environment. For Windows NT systems, we considered the results of tests on which we time operations of common graphics-related tasks using Picture Publisher for NT. For the Unix-based systems, scores are also based on the results of tests run using CorelDRAW and FrameMaker



April 12, 1994

PC Computing



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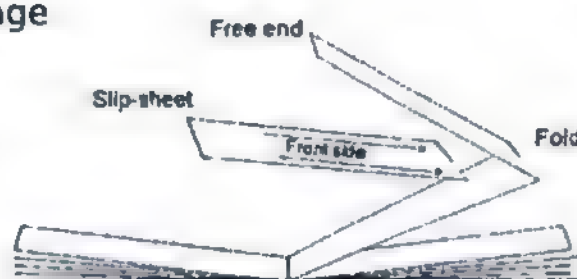
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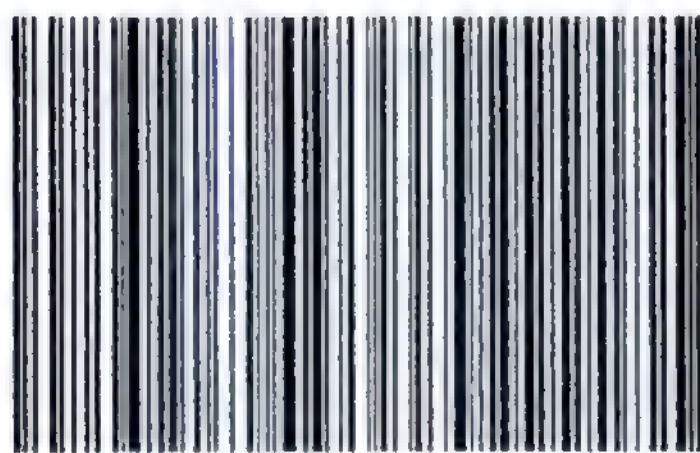
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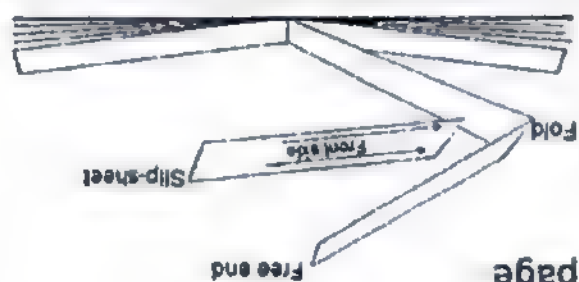


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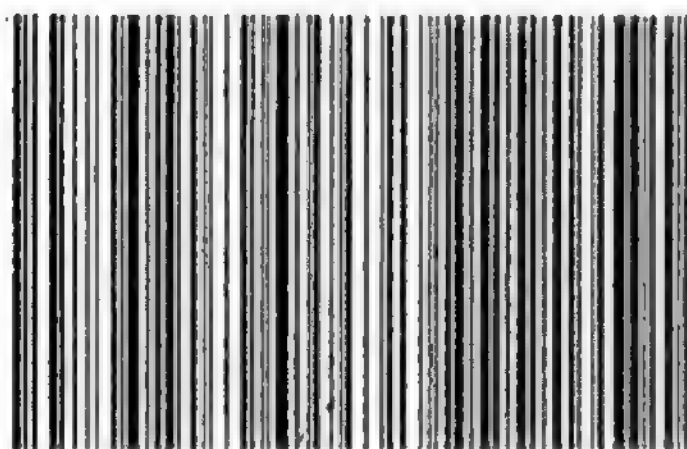
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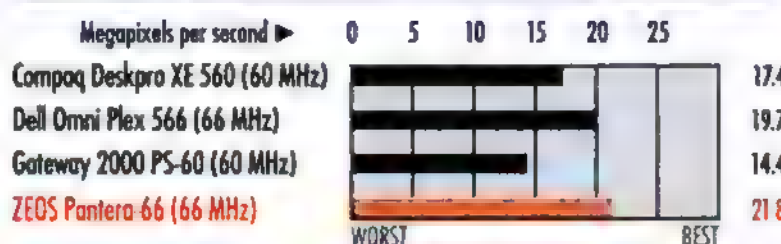
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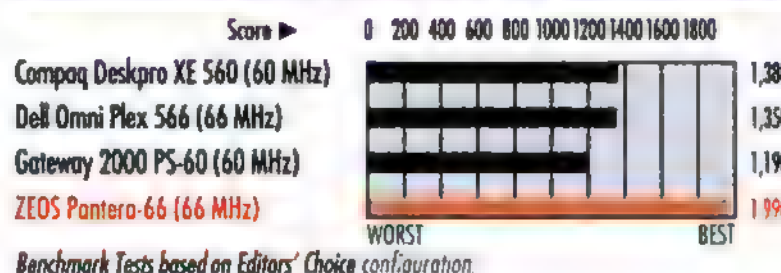
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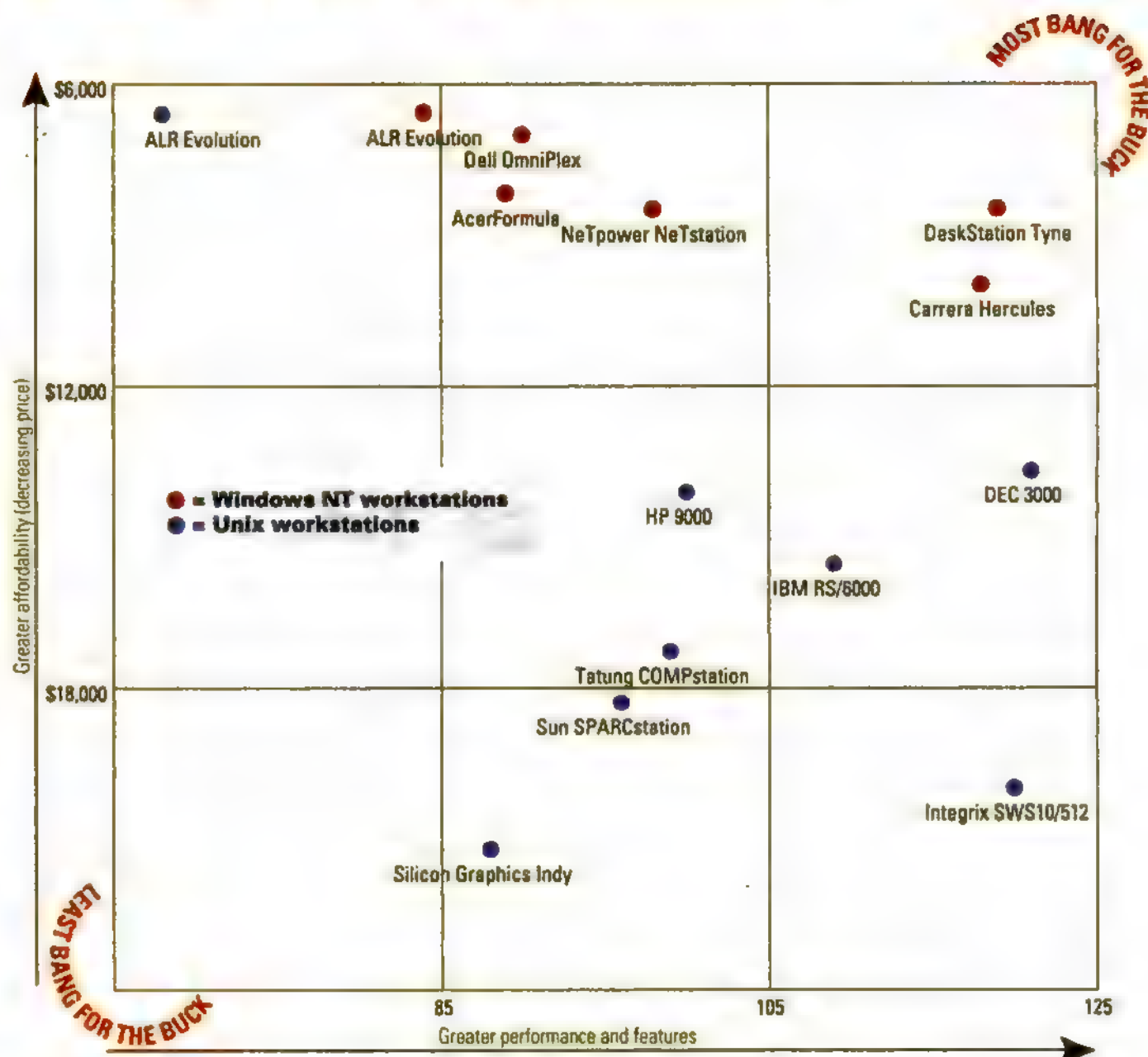
CIRCLE 155 ON READER SERVICE CARD

■ Price/Performance Index: RISC Workstations

Workstations are often designed to do a few things expertly, sacrificing performance in other areas. A workstation may be a bargain if its area of expertise matches your needs, but its overall performance may pull it down in terms of our rating. Our Editors' Choice winner—IBM's RISC System/6000 POWERstation 25T—was the best all-around workstation.

Thanks to prices that fall below \$10,000, the tested Windows NT workstations generally offer more bang for the buck than the tested Unix workstations, which range in price from about \$13,000 to \$21,195.

Carrera's Hercules 200 and the DeskStation Tyne v4633x are the performance bright spots among the NT workstations. The non-Intel-based Unix workstations are pricier than the NT systems, but the performance is generally better. Consider the DEC 3000 Model 300X AXP Workstation, the HP 9000 Model 712/80i, and IBM's RS/6000 if you are looking for a good value. The NT-based ALR Evolution V/60 did better on our price/performance index primarily because of superior graphics abilities.



THE DATA POINTS

Seventy-five percent of each system's performance/feature score was based on benchmark test scores. The sys-

tem's features determined the remaining 25 percent. You can find more data in the Hardware Library on ZiffNet under 10BANG.XLS.

SoftWindows may be that they can do what they do at all, rather than that they can do it very well.

There is another way to bring Windows to RISC workstations: Do it via hardware. Apple's new Power Macs support the existing body of Mac software designed to run on Motorola 68k chips, as well as new software written especially for PowerPC CPUs; this is achieved by encoding 68k emulation in ROM. Similarly, the expected PowerPC 615 chip, coming in about a year from IBM, will probably be able to perform both x86 and PowerPC work.

The key to success in this market is to seek the best economy of scale. This year, Intel is expected to ship over 40 million x86 CPUs, of which more than 6 million will be Pentiums of various speeds. The total RISC market is much, much smaller: Less than 300,000 units were shipped

worldwide in 1993. The clear winner among workstation makers is Sun Microsystems, which has garnered 44 percent of the market; Hewlett-Packard follows with 21 percent, IBM with 13 percent, and several other vendors with less than 10 percent apiece.

HOW THEY DO IT: VOLUME

Along with the overwhelming numerical advantage that Intel has in microprocessor volume, there is a pricing paradox in fast CPUs: Pentiums sell for about twice the price of RISC chips, but RISC chips offer up to two times the raw processing power of Pentiums. Intel's fatter profit margins on x86 chips are the envy of the RISC chip producers; Intel enjoys that price premium because of its x86 chips' compatibility with tens of thousands of DOS and Windows applications. But this scenario is going to change quickly as the

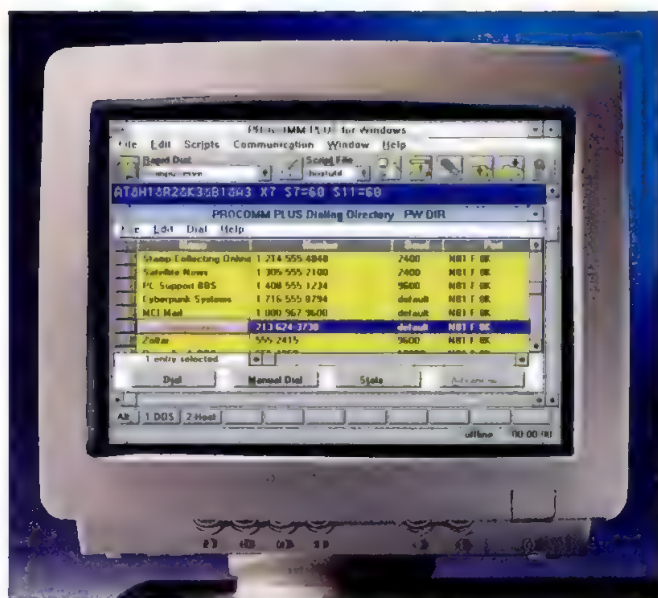
prices of 60-MHz and 66-MHz Pentium chips drop; Intel will be shipping in bulk the higher-performing and more profitable 90-MHz and 100-MHz Pentiums by the time you read this (even faster Pentiums may be available by the end of the year).

Meanwhile, the PowerPC alliance will be trying to turn the economy-of-scale argument in their favor. By contrast with the roughly 250,000-unit worldwide RISC market last year, the PowerPC group alone may ship 1.4 million chips this year—boosted by Apple's rapid conversion to PowerPC. In addition to desktop computers, we'll see PowerPC processors in automotive engine-management computers and in a new generation of TV set-top decoders being developed for the much-talked-about 500-channel future. It seems odd to look to these ancillary non-desktop computer markets for the volume

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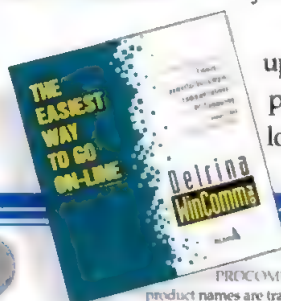
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needed to drive PowerPC prices down, but clearly computer users are going to be major if indirect beneficiaries of the move to more powerful embedded processors.

But the CPU accounts for only about one-fifth of a system's cost, at most. On the whole, RISC workstations are more expensive than PCs—the result of proprietary design and a lack of direct competition.

READ THE REVIEWS AND TESTS TOGETHER

If your world revolves around Pro Engineer, AutoCAD, or any of the other specialized workstation applications, you might be wondering which workstation to buy. Because of limited availability of applications under the many different varieties of Unix, it is certainly a lot harder to choose a workstation than it is to

choose a PC. The first step must be to look at what flavor of Unix a system supports and what applications are available.

As you read the reviews that follow, take a look at the performance charts that begin on page 150 for an indication of how well each of these systems handled a specific set of tasks. The low-level benchmark tests, such as the SPECmarks, Khormerstone, and Graphstone, tell part of the story. Look also at the results of our applications tests, and you'll get a good picture of each system's capabilities. Several workstations excelled in specific performance areas that their manufacturers have been able to exploit over the years. IBM's PowerPC-based RS/6000 is the clear leader in graphics, but the two-processor SPARCstation, from Sun, led the way on

our test of AutoCAD-based 2-D and 3-D graphics. The processor with the most raw computational power is Digital's Alpha chip, which graced both the DEC 3000 (in the Unix group) and the Hercules 200 (in the Windows NT group).

Based on the virtues of SCO Unix and UnixWare, the available applications and performance comparisons, the clear conclusion is that x86 systems cannot compete in the technical areas, where RISC-based workstations currently excel. While the ALR Evolution trailed the pack in Unix testing, both it and the Dell OmniPlex ranked in the middle of the pack under Windows NT. Pentium's obvious advantage came into play when we tested native Windows Excel code on the Pentium machines

■ RISC Workstations on the Go

With work sites increasingly being located away from the office, portable Unix workstations are a way of bringing the computer to the job. Far from being crippled systems with a handle and battery, the new generation of portable Unix systems are capable workstations that include audio, SCSI-2, PCMCIA slots, and even ISDN ports, allowing a full range of functions from complex mathematical computations to detailed industrial design work and multimedia on the road.

The 15-pound Sun Microsystems SPARCstation Voyager (left) is a full-featured workstation with a 12-inch active color screen (a 14-inch active monochrome display is also

available) powered by Sun's 60-MHz MicroSPARC II processor. It delivers a score of 43 on the SPECint92 benchmark test; its nickel cadmium battery pack can operate for about 2 hours on a charge. The system costs \$14,995.

The \$10,950 SPARCbook 3 (center), designed and manufactured by Tadpole Technology, uses Texas Instruments' 50-MHz microSPARC processor; it produces a SPECint92 score of 26. The SPARCbook 3's nickel hydride battery pack can last for about an hour, but an external nickel cadmium battery boosts that to 5 hours of continuous use. The 6.5-pound SPARCbook 3 has a 9.4-inch active color screen.

The IBM RISC System/6000 N40 (right) shares many components and design traits with the SPARCbook 3 and was designed in conjunction with Tadpole. Based on the 50-MHz PowerPC 601 chip running at 3.6 volts, the N40 produces a SPECint92 score of 41.7. Neither the SPARCbook3 nor the N40 includes an internal floppy disk drive, which is not surprising since a single Unix software title can easily consume dozens of high-density floppy disks. Both units rely on an integrated SCSI-2 host to connect to tape, CD-ROM, or 3.5-inch floppy disk drives to load software or copy data files. The IBM RISC System/6000 N40 is priced at \$11,995.—*Brian Nadel*



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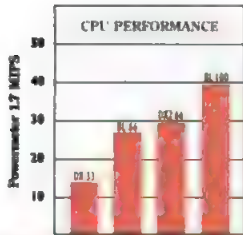
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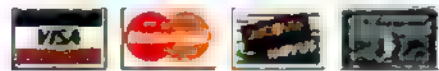
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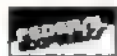
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versus Excel under the Windows emulations provided on the RISC machines. As expected, the RISC systems plodded, while Pentium soared.

IS RISC FOR YOU?

It's clear that if you want to run x86 applications—the DOS and Windows business applications that are the heart of the software market—your best choice today for price and performance is an x86-based computer. The whizzy-speed claims of the RISC workstation vendors pale next to the machines' inability to run popular applications at anywhere-near-acceptable levels of performance.

But with PowerPC CPUs with hardware x86 emulation coming, and with the growing maturity of Windows NT, that could change. Anyone who's worked with a Pentium machine may wonder just why we need this much speed. All but the most processor-intensive programs run very quickly on a Pentium PC. For almost all of today's Windows and DOS apps, we simply don't need RISC speed. But that will change. Coming up very soon are complex speech-recognition programs, which will allow us, for example, to dictate letters to our PCs—in a variety of languages. Speech recognition, especially in anything like real time, takes huge amounts of processing power. And graphics applications are getting bigger and much more video subsystem intensive. Anyone who's watched a Pentium PC slowly redraw an Adobe Photoshop image will tell you that today's fastest PCs aren't nearly fast enough.

There's also desktop teleconferencing. Intel CEO Andrew Grove jokes that Intel is investing heavily in development of desktop conferencing software (such as the company's new ProShare package) because "it absorbs CPU cycles like crazy," pushing Intel's customers toward ever-faster chips. Desktop conferencing has already overwhelmed standard phone lines—it demands fast ISDN lines—and if you want full-screen images, at standard 30-frame-per-second TV speed, you're going to buy a faster CPU, too. Other intersections with telephony—the growing field of computer telephone integration, or CTI—will demand much more power as well. Both Microsoft and Novell, for example, are telling customers to get ready to dump

their on-site PBX switchboards before long, replacing them with *telephony servers* on their LANs.

Maybe some of those apps will demand the power of RISC chips. And maybe the developments in Windows NT, the PowerPC alliance, and other corners of the computing world will, over the next two years or so, change the equation. But for now, the question of whether it's time to move up to RISC has two answers. If your needs are high-end graphics and computational ability, maybe a RISC workstation is the right choice. But for the general business app user, the answer remains unchanged: Not yet.

WINDOWS NT

Carrera Computers Inc.

Hercules 200

If you're looking for a fast, powerful RISC workstation that runs Windows NT, Carrera's Hercules 200—based on Digital Equipment Corp.'s Alpha processor—may be the answer. At \$9,995 it's not the least expensive Windows NT system available, but with the 200-MHz Alpha and a Carrera-modified DEC motherboard, it delivers impressive performance.

Carrera Computers currently sells the only 200-MHz Alpha system on the market, but that's because other companies that will have Alpha-based systems have chosen to wait until motherboards with PCI local-bus slots are available. When these boards are shipped, Carrera will offer PCI versions of its units as well. The Cobra series is another line of Carrera products that use Alphas; some of these units are PCI-ready. This line will include 275-MHz systems later this year. Carrera sells MIPS R4000- and R4400-based units, too, but is concentrating on Digital's high-powered Alpha chips.

The EISA-based Hercules is geared for the power user with a focus on floating-point-intensive applications like CAD and scientific programs. It came housed in a tower case complete with CD-ROM and tape backup, 64MB of system memory augmented by 2MB of external cache, and a 426MB SCSI-2 hard disk. The graphics system includes a 17-inch Mag monitor (standard) and a Compaq QVision video card with 2MB of video RAM.

Memory expansion is no trouble, with

▶ FACT FILE

Hercules 200

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Processor/memory: DEC

Alpha AXP 21064/200

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external cache Data stor-

age: Digital R225 426MB

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disk controller, Sony CDU-

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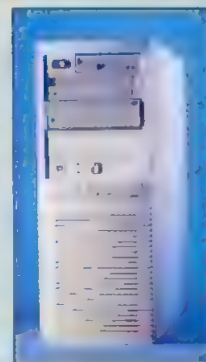
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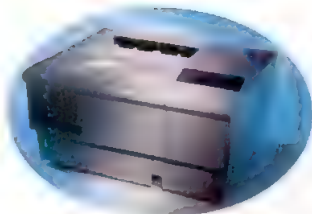
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eight easily accessible SIMM banks that allow for up to 256MB of RAM. Adding peripherals may be more problematic since the case has only one drive bay free, but EISA slots are in good supply, with four of six open.

The system's lack of software was its weak point, performance its strong one. It made a great showing on the suite of Stanford tests, with first-place scores among the NT systems on the floating-point portion and second place on the other two. The Alpha's terrific floating-point performance also helped the Hercules to the second highest score among all workstations on the Dhrystone test. Under Excel 16-bit emulation, however, and on the Graphstone test, it had poor results. On the applications tests, the power of the Alpha compensated for the middling graphics subsystem and propelled the unit to first place among NT systems on the Pro Engineer and the Picture Publisher tests—where both scores remain excellent even when compared with those of Unix workstations—and to second place on the PV-Wave test. Because no Fortran compiler was available for the Alpha NT platform at the time of testing, we could not run the Khornerstone or Whetstone tests.

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Advanced Logic Research Inc.

ALR Evolution V/60

The ALR Evolution V/60 earned distinction with an Editors' Choice award in an earlier look at Pentium systems ("Pentium: The Second Wave," *PC Magazine*, January 25, 1994), so we brought it back to see how it stacked up against some of the best machines the RISC world has to offer. At \$6,570, it's priced lower than most RISC workstations and offers competent though

not outstanding performance.

This 60-MHz Pentium unit is positioned as a high-end workstation. A 17-inch monitor and Matrox video card with 2MB of VRAM makes it well suited for graphics-intensive applications such as desktop publishing, and ALR is looking into video cards with higher capabilities. The unit also had two 540MB IDE drives, a hard disk controller with 4MB of cache, a Texel dual-speed CD-ROM, 32MB of RAM (upgradable to 128MB), and a 256K cache. There's a moderate amount of room for expansion: two bays, one VL-bus slot, and three ISA slots left open.

The Evolution's emphasis on high-end graphics components helped it gain an excellent Graphstone score compared with the other Windows NT machines

tested. Since it uses an Intel processor, this unit proved adept on our 16-bit Excel test. Its scores on the Stanford test suite and the Dhrystone test were not very competitive, however, for the same reason. Khonerstone test results were below average, in part due to the Intel processor but also due to a slower Conner IDE disk subsystem. You might want to consider a SCSI disk subsystem instead. The lack of optimized Pentium and Windows NT compilers hurt the system on the Whetstone test, but the Evolution made up for that on our applications tests, turning in a solid performance for both PV-Wave and Picture Publisher.

ALR's warranty for the system covers five years on parts and 15 months on service; a year of on-site service costs a nominal \$9.95.—*AY*

How the Chips Stack Up

Now that Intel is rolling out new speedier, low-voltage Pentiums, RISC CPU vendors are responding with lower voltages and faster clock speeds.

ALPHA Digital Equipment Corp.'s Alpha AXP 21064 CPU is RISC's speed demon, operating at up to 275 MHz. The 21064 is a full 64-bit design that can execute up to two instructions per clock. But sales have been weak, in part because there are few applications for this platform.

HP PA-RISC Hewlett-Packard's PA-RISC architecture has long been a force in the workstation market. The flagship member of this family is the PA-7100, a 32-bit superscalar design running at 100 MHz. This year, HP rolls out the PA-7100LC, a new low-power superscalar CPU that runs at up to 100 MHz.

IBM PowerPC Currently available from the PowerPC family is the PowerPC 601, a 3.6-volt, 32-bit design

running at speeds up to 80 MHz and able to execute up to three instructions per clock cycle. The future for this CPU family includes the forthcoming low-power 603. But, much like the Alpha, the PowerPC's workstation future lies in applications development.

MIPS MIPS Technologies' R4000 CPU family includes the high-performance R4400 series and the new R4600 series. The nonsuperscalar R4400's top clock speed is currently 150 MHz, and the R4600 runs at internal clock speeds of up to 133

MHz. The R4000SC is on the low end of the R4000 family and has separate data and instruction caches of 8K each.

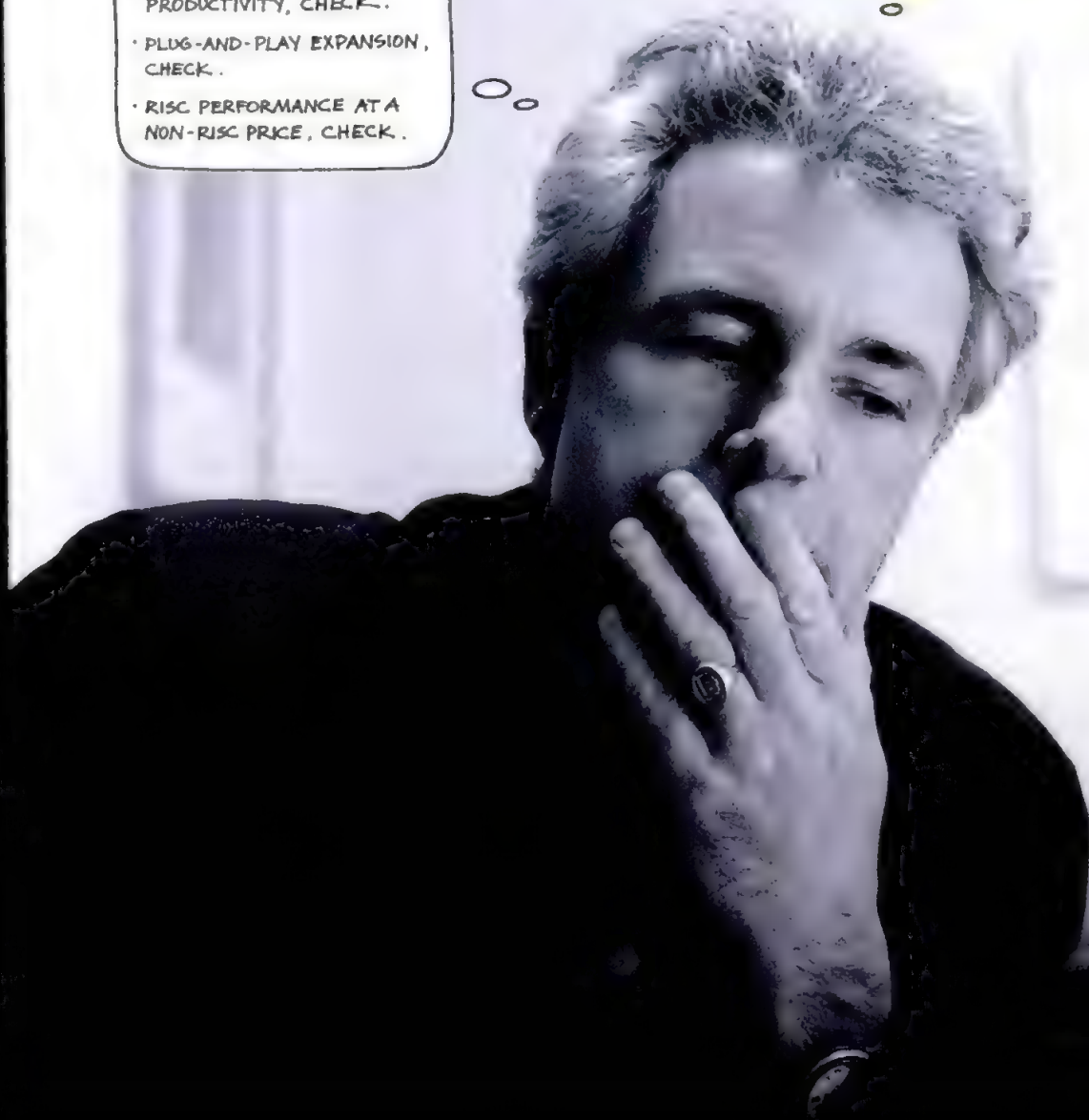
Sun SuperSPARC Sun Microsystems' SPARC CPUs includes MicroSPARC II, a low-power, uniprocessor version; SuperSPARC, capable of multiprocessing; and UltraSPARC, a 64-bit design slated for 1995. Of the RISC vendors, Sun may be the most vulnerable: It has the users and the apps, but it doesn't offer the speed or floating-point performance of its competitors.—*Carol A. Venezia*

Processor	Manufacturer	Cache size	Separate data and instruction caches	Architecture		Superscalar	Clock speed (MHz)	Claimed SPECint8 score (SPECmarks)	Claimed SPECfp8 score (SPECmarks)
				Internal	External				
DEC Alpha AXP 21064	Digital Equipment Corp.	16K	Yes	64-bit	64-bit	Yes	200	130.0	184.0
HP PA-7100LC	Hewlett-Packard Co.	N/A	N/A	32-bit	64-bit	Yes	80	84.0	122.0
IBM PowerPC 601	IBM Corp.	32K	No	32-bit	64-bit	Yes	85	75.0	80.0
Intel Pentium	Intel Corp.	16K	Yes	32-bit	64-bit	Yes	60-66	62.9-70.0	55.1-63.6
MIPS R4000SC	Integrated Device Technology, NEC, Toshiba	16K	Yes	64-bit	64-bit	No	100	58.3	51.5
MIPS R4400	Integrated Device Technology, NEC, Toshiba	32K	Yes	64-bit	64-bit	No	150	94.5	105.2
MIPS R4600	Integrated Device Technology, Toshiba	32K	Yes	64-bit	64-bit	No	133	92.7	92.0
Sun SuperSPARC	Texas Instruments	36K	Yes	32-bit	64-bit	Yes	50	73.0	85.0

N/A—Not applicable: The product does not have an internal cache.

- OUTPERFORMS 486 AND PENTIUM, CHECK.
- WORKS WITH MS-DOS, CHECK.
- WORKS WITH WINDOWS, CHECK.
- MEETS CORPORATE NETWORK STANDARDS, CHECK.
- INCREASES EMPLOYEE PRODUCTIVITY, CHECK.
- PLUG-AND-PLAY EXPANSION, CHECK.
- RISC PERFORMANCE AT A NON-RISC PRICE, CHECK.

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REALLY COOL STUFF.



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The power of RISC for as little as \$1,819.*

The whole computer industry is buzzing about the potential of RISC technology in PCs.

"My next computer will be a PowerPC. I was using Intel-based machines long before the PC was a glimmer in IBM's eye, but as Emerson said, foolishly held consistency is the hobgoblin of little minds.... It's time for a change, and the time is now," wrote Bill Machrone in *PC Week*. "That next machine will probably wear an Apple logo.... Apple appears to be a good six months ahead of IBM in terms of [PowerPC] product development and software integration."

Plug-and-play Ethernet networking is standard. So is plug-and-play expansion capability. So is CD-quality sound. Put it all together, and you've got a whole new way to think about Macintosh.

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You can hardly pick up a magazine these days without reading about how the worlds of video, sound, telephones and computers are coming together. About new developments like speech recognition, desk-to-desk videoconferencing and integrated voice mail. About how documents of the future will include not just text, num-

Software accelerated for Power Macintosh.

This is just a fraction of the software that is now or soon will be available in versions accelerated for Power Macintosh.

ACI 4th Dimension	Macromedia Authorware Professional
Adobe Illustrator	Macromedia Director
Adobe Photoshop	Macromedia MacroModel
Adobe Premiere	Microsoft Excel
Agfa-Gevaert N.V.	Microsoft Word
Aldus FreeHand	Nisus Writer 4.0
Aldus PageMaker	Oracle7
Aldus Persuasion	QuarkXPress
Alias Sketch!	Radius RocketShare
auto•des•sys form•Z	Radius VideoVision Studio
Claris ClarisWorks	RasterOps Horizon 24
ClarisImpact	Ray Dream Designer
Electric Image Animation System	Scitex Corporation Ltd.
Fractal Design Painter	Specular International Infini-D
Frame FrameMaker	Strata StudioPro
Graphisoft ArchiCAD	SuperMac cards and peripherals
Great Plains Dynamics Release Two	VideoFusion
Insignia Solutions SoftWindows	Virtus WalkThrough
Language Engineering LogoVista E to J	Wolfram Research Mathematica
Leaf Systems	WordPerfect 3.0
Lotus cc:Mail	WordPerfect Office

bers and graphics, but sound, video clips and animation.

To make the most of these vast new capabilities, you'll need to have the power of RISC technology—and the simplicity of Macintosh.

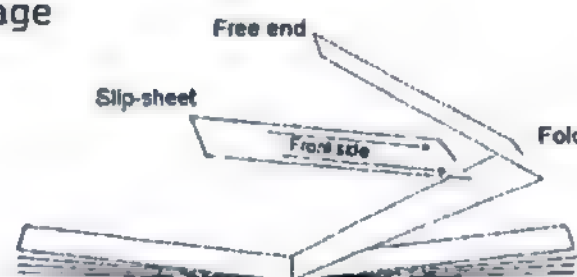
Of course, there's no better way to understand the power of Power Macintosh than to try one today at your authorized Apple reseller (for the name of one located near you, call 800-732-3131, ext. 600).

And see just how much more power a Macintosh can give you. The power to be your best.*

Introducing Power Macintosh.



1. Open the foldout page
2. Insert this sheet with
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 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Foldout slip-sheet

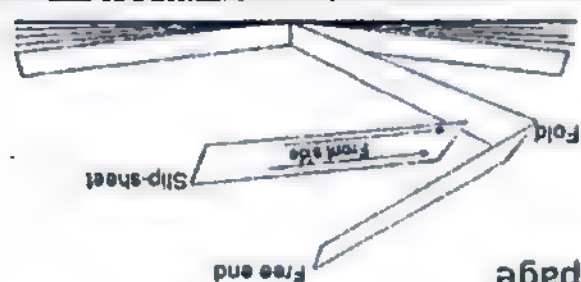


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Inverted Foldout slip-sheet

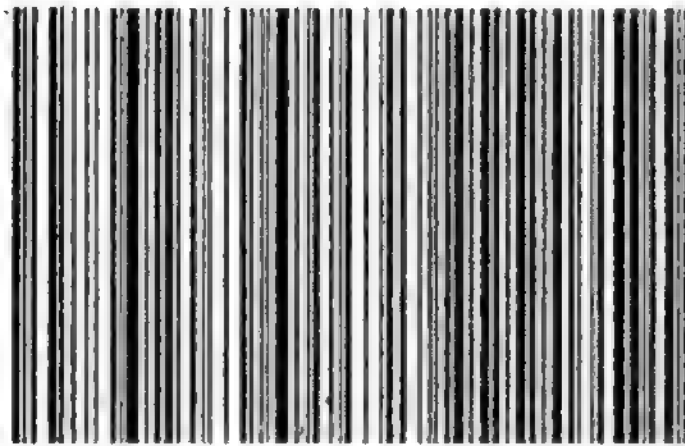
Folded edge of the page

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



GbsSlpBack-0018

Back

1. Follow instructions on the other side

Think of it as the Macintosh for people who thought they could never have a Macintosh.

Check your preconceptions at the door.

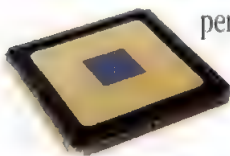
This isn't just a new family of Macintosh® personal computers. It's a whole new kind of personal computer.

A new architecture. A new chip. A new standard that exceeds previous personal computing standards—yet works with MS-DOS, Windows and Macintosh.

Introducing Power Macintosh™ personal computers. More powerful than a Pentium processor-based PC. More human than Macintosh. The most powerful personal computers in the world.

The power of Apple, IBM and Motorola.

At the heart of Power Macintosh is the PowerPC™ 601 microprocessor: the first of a new family of ultra-high-performance RISC chips developed in a unique three-year collaboration between Apple, IBM and Motorola.



The PowerPC 601 has a lot of power inside it: the combined resources of IBM, Motorola and Apple.

RISC technology brings a whole new level of performance to personal computing. Software written to take advantage of its unique capabilities, in fact, will blow the doors off the same programs written for 486 PCs—and will run significantly faster than programs for Pentium processor-based PCs.

RISC technology makes everything work faster: from 3-D modeling applications that require

From left, the Power Macintosh 8100/80, Power Macintosh 7100/66 and Power Macintosh 6100/60.

Power Macintosh	6100/60	7100/66	8100/80
Processor	PowerPC 601	PowerPC 601	PowerPC 601
Speed	60 MHz	66 MHz	80 MHz
Memory	8MB to 72MB	8MB to 136MB	8MB to 264MB
Expansion slots	1 PDS or NuBus	3 NuBus	3 NuBus
Hard disk storage	160MB or 250MB	250MB or 500MB	250MB to 1GB
Video support	DRAM	DRAM, VRAM 1MB to 2MB	DRAM, VRAM 2MB to 4MB
Networking	Ethernet	Ethernet	Ethernet
Apple Price	From \$1,819	From \$2,899	From \$4,249

All this plus built-in Macintosh PC Exchange, AppleScript,* QuickTime* software, TrueType® fonts, GeoPort® serial ports, 16-bit stereo audio input and output, file sharing without a dedicated server and more.*

floating-point computations to basic business software.

Combine the increased power of RISC with the practical simplicity of a Macintosh, and the result is more work done in less time, with lower training and support costs.

The power to run MS-DOS, Windows and Macintosh software.

Many Power Macintosh configurations come bundled with SoftWindows, a software innovation that enables Power Macintosh to run hundreds of off-the-shelf MS-DOS and Windows programs at 386 and 486 performance levels. (Of course, every Power Macintosh can run thousands of Macintosh personal productivity programs, too.)

But that's just the beginning. "By the end of 1994," wrote *PC/Computing*, "you'll see



*Effective 3/14/94. Apple Price includes the Power Macintosh 6100/60 with 8MB of memory and a 160MB hard drive. For the sake of custom configuration, keyboard, monitor and mouse are sold separately. Unless bundled with a particular configuration, SoftWindows must be purchased separately. TrueType are trademarks of Apple Computer, Inc. PowerPC is a trademark of International Business Machines Corporation, used under license therefrom. SoftWindows is a trademark of Insignia Solutions Inc.

COVER STORY

RISC Workstations



► FACT FILE

ALR Evolution V/60

List price: \$6,570. **Processor/memory:** Intel Pentium/60 CPU, 32MB RAM, 256K external cache
Data storage: Two Conner CFA-540A 540MB IDE hard disks, Alpha Research DC-680 VL-Bus hard disk controller with 4MB of cache, Texel 3028 CD-ROM drive
Display: Matrox MGA II video controller with 2MB of VRAM, ALR FlexVIEW 4XNI 17-inch monitor with a 72-Hz refresh rate at 1,280-by-1,024 **Software:** DOS 6.2, Microsoft Windows NT

Advanced Logic
 Research Inc., 9401
 Jeronimo, Irvine, CA
 92718, 800-444-
 4257, 714-581-6770;
 fax, 714-581-9240.
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SUITABILITY TO TASK	
Computational ability	GOOD
Expandability	GOOD
Engineering/scientific/CAD	FAIR
Graphics/publishing	EXCELLENT

pied, although the two PCI and three EISA expansion slots were free for future use. This system also features a 224-watt power supply with five connectors for those interested in expansion.

An integrated ATI video controller equipped with 2MB of VRAM helped the OmniPlex achieve an impressive Graphstone test score. The system's Khronerstone score was reasonable, though still a couple of notches below scores posted by the top Windows NT RISC performers, and the Dhrystone score was below average. But because of its 66-MHz Pentium processor, the OmniPlex, running Windows natively, turned in the top score on our 16-bit Excel test.

As with ALR's unit, the lack of Pentium NT-optimized compilers hurt the OmniPlex on the Whetstone tests, but because the MIPS RISC NT workstations had equally problematic compilers, the OmniPlex came up with the best score on the double-precision Whetstone test. As expected, the OmniPlex did very well on applications tests that ran on the Intel platform. Because of either hardware or compiler incompatibility, however, it was unable to run any of the Stanford tests.

Dell offers a one-year warranty with this system, including on-site service, and also

has a 24-hour, 7-day, toll-free technical support line. The Dell OmniPlex 566 gives you a good value for the price and allows you to stay with the familiar Intel platform.—AY

Acer America Corp.

AcerFormula 4400

The \$8,179 AcerFormula 4400, based on the 150-MHz MIPS R4400 processor, delivers adequate but not star-quality performance when compared with other NT systems in this workstation roundup.

Acer is a company that has been around for a while and is familiar to users of Intel- and non-Intel-based computers. A similar Acer-built product shows up elsewhere in this review cloaked as the NeTpower NeTstation 300, although the latter runs at a higher speed. The AcerFormula is aimed at the high-end technical workstation market.

The AcerFormula came with 32MB of RAM (expandable to 128MB) and a 128K cache. Unfortunately, the cache is fixed at 128K so you can't upgrade to improve performance. The system also had a 1.04GB Fujitsu SCSI-2 drive run off an adapter on the proprietary PICA bus (the adapter also ran most of the I/O ports), a dual-speed Toshiba CD-ROM

Dell Computer Co.

Dell OmniPlex 566

The Dell OmniPlex 566 is another machine that's making a return appearance, this time for winning an Editors' Choice award (reviewed in "Unleashing the Power of the Pentium," *PC Magazine*, April 12, 1994). As you would expect, its \$7,007 price is better than that of comparably equipped RISC stations, but its performance on most of our benchmark tests, although good, was still not quite up to that of the RISC-based systems in this roundup. Dell does not sell NT, and we had to purchase it; that price is not included in the system cost.

This general-purpose high-end workstation came equipped with a 66-MHz Pentium processor, 32MB of system memory (expandable to 192MB) backed by 256K of external cache, a standard SCSI-2 subsystem with a 1GB disk drive, integrated hard disk and video controllers, a Toshiba dual-speed CD-ROM drive, a dual 1.44MB/1.2MB floppy disk drive, and a 15-inch monitor (Dell also offers a 21-inch monitor with this system). All drive bays but one were occu-



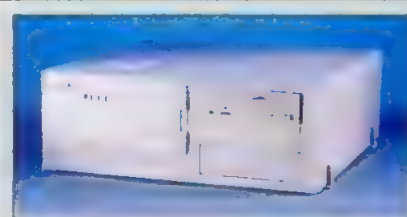
► FACT FILE

Dell OmniPlex 566

List price: \$7,007 **Processor/memory:** Intel Pentium/66 CPU, 32MB RAM, 256K external cache
Data storage: DEC DSP3105 1GB SCSI-2 hard disk, integrated NCR 53C810 PCI local-bus hard disk controller, Toshiba XM-3401B CD-ROM drive **Display:** Integrated ATI 68800AX PCI local-bus video controller with 2MB of VRAM, Dell UltraScan 15ES 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Microsoft Windows 3.1

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 Blvd., Austin, TX
 78759; 800-289-
 3355, 512-338-4400;
 fax, 512-728-3653.
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SUITABILITY TO TASK	
Computational ability	GOOD
Expandability	GOOD
Engineering/scientific/CAD	GOOD
Graphics/publishing	EXCELLENT



► FACT FILE

AcerFormula 4400

List price: \$8,179 **Processor/memory:** MIPS R4400/150 CPU, 32MB RAM, 128K external cache **Data storage:** Fujitsu M2694ESA 1.04GB SCSI hard disk, Acer GIO local-bus controller, Toshiba XM-3401B CD-ROM drive **Display:** Acer America S3/805 GUI video controller with 2MB of VRAM, Acer America AcerView 76i 17-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024 **Software:** DOS 6.2, Microsoft Windows NT.

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SUITABILITY TO TASK	
Computational ability	EXCELLENT
Expandability	GOOD
Engineering/scientific/CAD	GOOD
Graphics/publishing	GOOD

Way to go, Apple.



Apple's new Power Macintosh™ computers are here. Based on the new PowerPC™ microprocessor, they truly have the power to change the course of computing. So congratulations, Apple. Way to go, go, go.

PowerPC Microprocessors. *A change for the better.*



MOTOROLA

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Performance Tests: RISC Workstations

The overall performance of RISC workstations was not dominated by any one phase but is an amalgam of low-level testing and applications performance.

What the Numbers Mean

LOW-LEVEL BENCHMARK TESTS

We ran two **SPECmark** benchmark tests: SPECint92, a measure of integer operations, and SPECfp92, a measure of floating-point operations. These tests run only under Unix. The three workstations in this lineup with Sun SuperSPARC CPUs—the Integrix SWS10/512 50MHz SPARCstation 10, Tatung's Super COMPstation 10 Model 51, and Sun's SPARCstation 20 Model 502—led the pack on the SPECint92 test. The two processors carried by the Integrix and Sun entries can partially explain the impressive performance of these systems. To see whether compilers would make a difference, we tested Sun's unit with both the preinstalled SunPro compiler and the Apogee compilers that came with the Integrix and Tatung units. While the Apogee compilers proved more capable, they did not improve performance dramatically, pointing to system design as a final differentiator.

The Silicon Graphics Indy (with a 100-MHz R4000SC CPU) and Digital's DEC 3000 Model 300X AXP Workstation (with a 175-MHz Alpha CPU) were at the bottom of the heap on the SPECint92 test—further proof that there are many other factors to consider besides CPU speed when looking at workstations.

On the SPECfp92 test, a similar scenario emerged among the units with SunSPARC architectures: The Integrix and Tatung units both outperformed Sun's SPARCstation. But contrary to what it achieved on the SPECint92 test, the DEC 3000 was number one on the SPECfp92 test by a wide margin. Silicon Graphics' Indy showed an improvement; it outperformed the ALR Evolution V/60 under both SCO Unix and Novell UnixWare. UnixWare's FORTRAN compiler appears better tuned for the Pentium than SCO's compiler does: With UnixWare, the ALR Evolution topped its own performance under SCO Unix by more than 20 percent.

The Unix-only **Xmark** tests produce an overall graphics score for each system. IBM's RISC System/6000 POWERstation 25T (with a 66-MHz PowerPC 601 CPU) turned in the highest score. This unit has a hot video subsystem based on IBM's GTX 150 graphics controller, which helped the RS/6000 outperform Hewlett-Packard's HP 9000 Model 712/80i—itsself an impressive graphics machine—by about 40 percent. The ATI Mach32 card in the ALR Evolution (under either SCO Unix or UnixWare) did not help this system on our Xmark tests, thanks to the lack of fully optimized drivers.

The **Graphstone** tests, which execute a variety of drawings, are a gauge of video performance. As on the Xmark tests, IBM's RS/6000 took first place, and the HP 9000 took second. The top-performing NT workstation was the DeskStation Tyne v4633x, which uses an Appian VL-Bus card with 2MB of VRAM.

The **Khornerstone** tests measure each system's CPU, floating-point unit (FPU), and disk performance. With the Alpha's exceptional floating-point ability, the DEC 3000 captured the top spot on these tests. The ALR

Evolution, under UnixWare, overcame a low disk score to take second place. Under SCO Unix, the ALR Evolution could not overcome this hurdle: It finished dead last. The Alpha-based Carrera Hercules 200 and DEpc AXP 150, running Windows NT, could not perform these tests because of a lack of FORTRAN compilers.

The **Dhrystone** tests are CPU-intensive tests that measure programming application performance. Based on these tests, the Alpha platform is a programmer's dream: The DEC 3000 captured the number-one Dhrystone score, followed by Carrera's Hercules NT workstation. The ALR Evolution received a high score under both SCO Unix and UnixWare. Apparently, the C compilers in both flavors of Unix are about equally optimized for the Pentium.

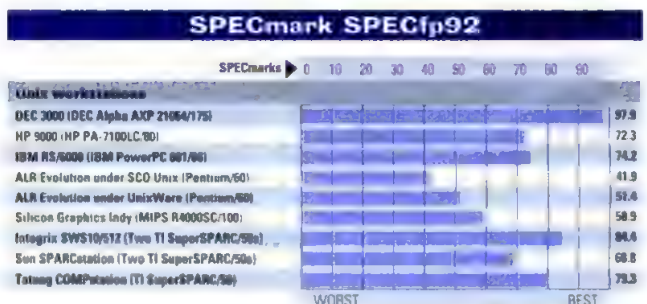
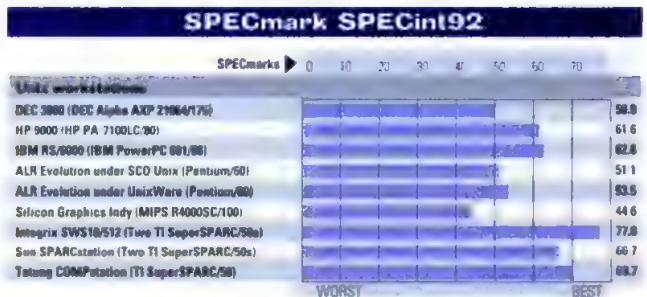
The single- and double-precision **Whetstone** tests simulate FPU-intensive applications. The DEC 3000 ranked number one on both Whetstone tests. The HP 9000, the ALR Evolution, and Sun's SPARCstation also showed potential for running a variety of 32-bit FPU-intensive applications. The single-precision version was the only test on which Sun's workstation far outpaced its Integrix and Tatung clones. The Sun compilers made the difference.

On the double-precision Whetstone test, Sun's compilers did not provide the SPARCstation with the same performance edge. Most other workstations' scores on this 64-bit test were more or less in line with their 32-bit performance. The DEC 3000 maintained its lead, and the ALR Evolution (in both Unix configurations) turned in strong scores. The Alpha-based Carrera Hercules and DECpc AXP 150 could not run these tests because no FORTRAN compilers were available.

STANFORD TESTS

The Stanford test suite exercises processor-level functions concurrently, demonstrating a workstation's ability to manage multithreaded applications.

All the NT workstations we tested contain CPUs with built-in floating-point units that can operate at full CPU speed. This explains the overwhelming performance lead of Carrera's Alpha-based 200-MHz Hercules 200 on the



Stanford Floating-Point tests. In view of the fact that the three MIPS-based machines—the AcerFormula 4400, DeskStation Tyne v4633x, and NeTpower NeTstation 300—boast internal clock speeds of 133 MHz or higher, the ALR Evolution, with its 66-MHz Pentium, did an impressive job of keeping up the pace.

In our Unix group, Digital's DEC 3000 Model 300X AXP workstation did well here. But as more processes were added, it was outperformed by the Integrax SWS10/512 50MHz SPARCstation 10 and by Sun's SPARCstation 20 Model 502, both of which pack two 50-MHz SuperSPARC chips. Half as fast as the Integrax were the ALR Evolution V/60 (running UnixWare), Hewlett-Packard's HP 9000 Model 712/80i, IBM's RISC System/6000 POWERstation 25T, and the Silicon Graphics Indy.

On the **Stanford Integer** tests, the 133-MHz MIPS-based DeskStation Tyne and the 200-MHz Alpha-based Carrera Hercules showed strong integer performance—especially with multiple processes. On the Unix side, most of the workstations maintained fairly equal integer performance when handling up to eight concurrent processes, but Tatung's Super COMPstation 10 Model 51, with one 50-MHz SuperSPARC chip, had difficulty handling more than one process. The Integrax SWS10/512 and Sun's SPARCstation did well at balancing higher loads.

Within both workstation classes (NT and Unix), system performance on the **Stanford Recursion** tests sorted out roughly by CPU capacity and speed. Among the NT systems, the MIPS-based workstations turned in the best scores, along with the Alpha-based systems, grouping together at every process load. The 60-MHz Pentium-based ALR Evolution brought up the rear. Among the Unix machines, the dual-SuperSPARC-powered workstations by Integrax and Sun led the pack. The Dell OmniPlex 566, with its 66-MHz Pentium,

could not run any of the Stanford tests; this had more to do with the unit's system design at the time of testing than with the Pentium itself.

WINDOWS EMULATION TESTS: 16-BIT EXCEL

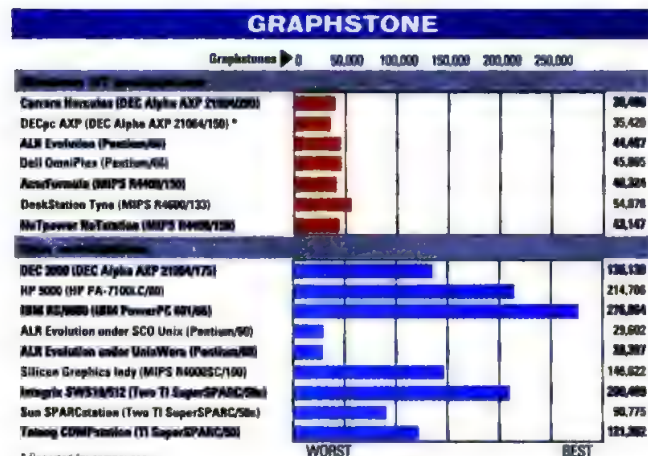
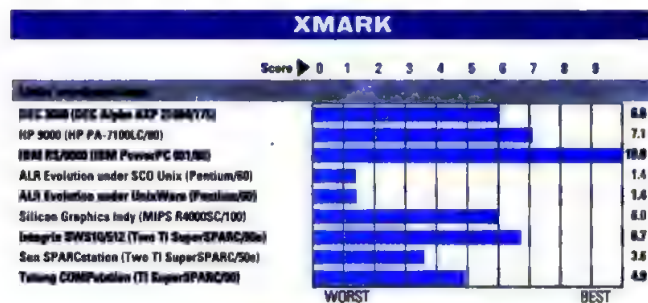
The Windows NT workstations in this roundup ran the standard Windows version of Microsoft's Excel spreadsheet program at a higher video resolution than workstations with either SoftWindows or Wabi installed because of the limitations of those two Windows emulators. Even so, the two Intel Pentium-based systems—the ALR Evolution V/60 and the Dell OmniPlex 566—led the pack because they ran the Windows applications in native mode.

Under SoftWindows, the Integrax SWS10/512 50MHz SPARCstation 10 (with two SuperSPARC/50 processors) and the RISC System/6000 POWERstation 25T (with an IBM PowerPC 601/66 processor) far outpaced the competition. Tatung's Super COMPstation 10 Model 51 with a single SuperSPARC/50 processor ran Excel about 23 percent faster within Wabi than within SoftWindows.

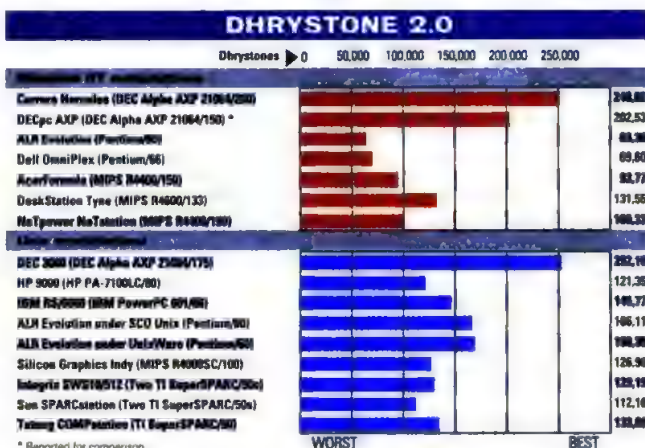
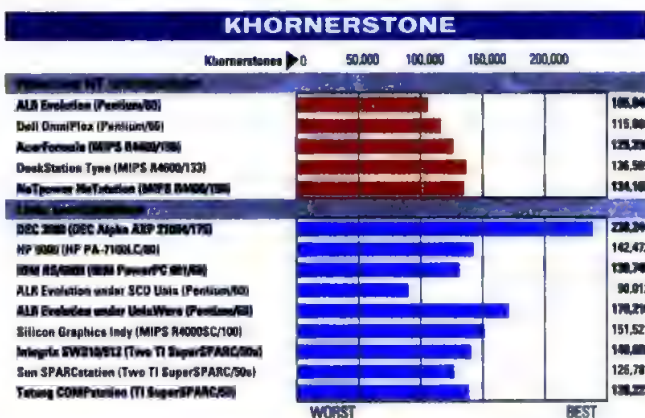
The HP 9000 Model 712/80i and Silicon Graphics Indy were both slowest when running Excel under SoftWindows. At the time of our testing, however, SoftWindows was available only in beta form. The DEC 3000 and the ALR Evolution could not run these tests because neither SoftWindows nor Wabi was available on these platforms.

APPLICATIONS TESTS

When we correlated core component performance with the ability to run **CorelDRAW**, none of the systems met our expectations. IBM's RISC System/6000 POWERstation 25T, which headed the charts in all our graphics



* Reported for comparison



* Reported for comparison

portable.

IBM



ThinkPad 350C

ThinkPad 350C (color)

- 486SL 25MHz processor with 8KB internal cache
- 4MB RAM/250MB hard drive
- 3.5" 1.44MB diskette drive
- 11.7" w x 8.3" d x 2.0" h 5.7 lbs. with battery pack
- 9.2" STN backlit LCD 256 color display
- Full-size keyboard w integrated TrackPoint II
 - PCMCIA slot
 - IBM DOS pre-installed
- 1-year international traveler's warranty

\$2,699* IBM Credit Lease
\$65/mo. **

ThinkPad 350

- 486SL 25MHz processor with 8KB internal cache
- 4MB RAM/125MB hard drive
- 3.5" 1.44MB diskette drive
- 11.7" w x 8.3" d x 1.9" h 5.2 lbs. with battery pack
- 9.5" monochrome STN backlit LCD display 64 grey scales
- Full-size keyboard w integrated TrackPoint II
 - PCMCIA slot
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Performance Tests: RISC Workstations

subsystem tests, lagged on our CorelDRAW test, although the results were tightly spaced. And since disk access played a big role in that test, we expected the Silicon Graphics Indy, with its fast disk subsystem, to perform better. Since the Integrix SWS10/512 produced good integer scores throughout all the low-level tests, its first-place finish makes some sense. Yet its runner-up on the CorelDRAW test—the HP 9000 Model 712/80i—was not very strong on integer functions. Because so much of the performance on this test was erratic, we can only surmise that the CorelDRAW ports to these varying Unix platforms are far from equal.

Contrary to their showing on the AutoCAD tests, where workstations based on Sun SuperSPARC chips performed best, the Integrix SWS10/512, Sun SPARCstation, and Tatung COMPstation were virtually tied for last place on the **FrameMaker** test. Since the Integrix and Sun workstations both have two 50-MHz SuperSPARC CPUs and ran at virtually the same speed as the single-processor Tatung COMPstation, clearly FrameMaker's code is not designed to scale CPUs.

Since FrameMaker is not available for an Alpha-based unit, we could not test the DEC 3000. We tested the ALR Evolution with FrameMaker running under SCO Unix and Unixware, but since only an earlier version of FrameMaker was available for these operating systems, the test results were not directly comparable.

Pro Engineer makes heavy demands on a unit's video and floating-point system. But Carrera's 200-MHz Alpha-based Hercules 200, packing a Compaq QVision video card, managed to perform well against some stiff competition from the Unix camp. On our Graphstone tests, the inherent drawing ability of the QVision card did not amount to much, but the EISA slot's speed advantage

in transmitting data to the Hercules display subsystem paid off. We were unable to test Pro Engineer on the Intel-based NT workstations because it would not run properly, and we were also unable to test it on the ALR because it was not available for Intel-based Unix.

Strong video performance and a fast disk are vital in **PV-Wave**, a highly visual scientific analysis program. It's no surprise that the DEC 3000 Model 300X AXP workstation, the Unix system most often at the top of floating-point charts, took first place in the PV-Wave test. The Silicon Graphics Indy, offering the best disk performance and good video, took second place. The IBM RISC System/6000 POWERstation 25T and the HP 9000 Model 712/80i, which showed well-rounded performance in all three categories—CPU, graphics, and disk—were front-runners in the Unix field as well.

Tops among the NT workstations were the DeskStation Tyne v4633x, with the best video performance in its group, and the Hercules, with fast video and CPU scores. We were unable to test the ALR, because PV-Wave was not available for Intel-based Unix systems.

With three of our tested versions of Unix not supported in the current release of **AutoCAD**—Digital's OSF/1, as well as SCO Unix and UnixWare for the Intel Pentium—it is hard to say whether the top-performing models would otherwise keep their positions. According to our tests (the 2-D and the newer, more intense 3-D test), you would probably want to run AutoCAD on a system with either one or two SuperSPARC chips: The Integrix SWS10/512, Sun SPARCstation, and Tatung COMPstation, all running Solaris 2.3, show that AutoCAD is well tuned for their environment.

Carrera's Hercules 200 unit performed exceptionally well on the **Picture Publisher** test. The two Intel Pentium NT workstations—the ALR Evolution and Dell OmniPlex—also did well. Judging by the collective low-tier performance of all three MIPS machines (the Acer, DeskStation, and NeTPower), Picture Publisher has so far been better ported to the Intel platform.

—Analysis written by Tami D. Peterson

How We Tested

David Wilson of Workstation Labs (Humbolt, Arizona) performed the low-level testing.

The SPECmark scores are based on tests written in C and FORTRAN. Results are reported for both integer operations (**SPECint92**) and floating-point operations (**SPECfp92**). Currently, the SPECmark tests run on Unix operating systems only.

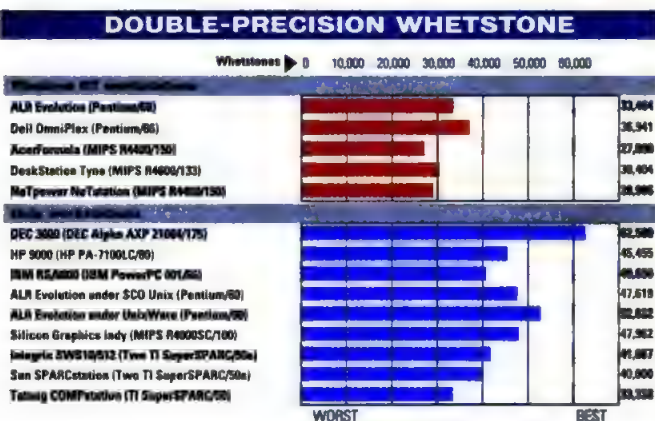
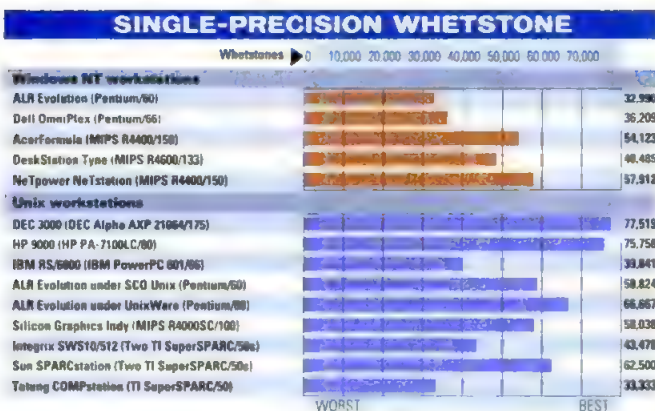
The **Xmark** score is a weighted geometric mean of a series of X11PERF graphics tests. These Unix-based performance tests are similar but not comparable with PC Magazine Labs' Windows-based Graphics WinMark benchmark test.

The **Graphstone** tests comprise 125 routines carried out with 13 different graphics types; they indicate overall graphical performance. The tests are written in C, and the raw scores are measured in operations per second.

Khornerstone results are calculated from 21 tests—written in C and FORTRAN—that stress each workstation's CPU, FPU, and disk subsystem.

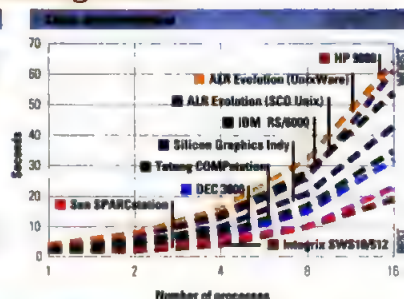
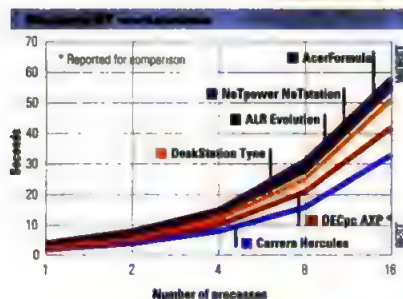
Dhrystone 2.0 is a series of CPU-intensive exercises written in C. These tests are useful for measuring the performance of systems' programming applications.

The single- and double-precision **Whetstone** tests are designed to simulate the FPU-intensive programs used in engineering and scientific fields.

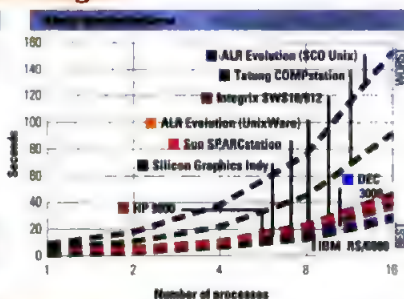
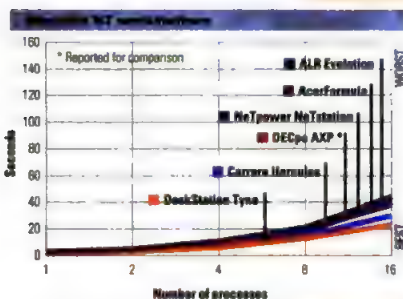


STANFORD TESTS

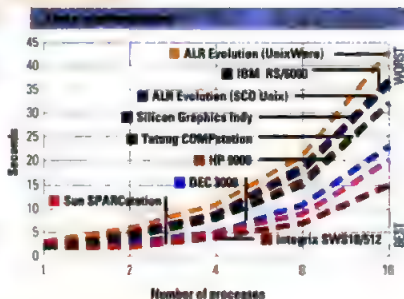
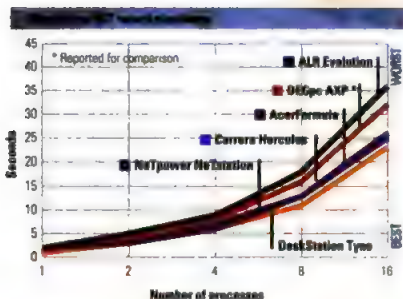
Stanford Floating-Point



Stanford Integer

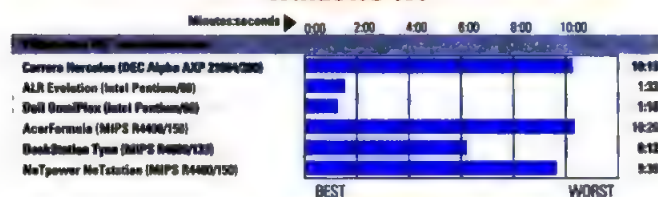


Stanford Recursion



WINDOWS EMULATION: 16-BIT EXCEL

Windows NT



SoftWindows



Wabi



At PC Labs, we ran ten "Stanford" test routines designed to assess a system's multitasking capability. Each routine is run as a single process and then as 2, 4, 8, and 16 concurrent processes. We classified the tests into three groups (floating-point, integer, and recursive operations); each point plotted on our graphs represents a product's average timing within the group of tests.

The **Stanford Floating-Point** test suite consists of three parts. *Mandel* uses the Mandelbrot fractal algorithm—which represents a form of matrix multiplication performed on complex numbers—to plot the Mandelbrot set through the points (-4.4, -2.4, 1.6, 2.4). *Floating-Point Matrix Multiply* and *Fast Fourier Transformation* are two standard gauges of a CPU's floating-point performance.

The **Stanford Integer** test suite consists of *Puzzle*, *intMM*, and *Tree*. *Puzzle* uses a processor-bound algorithm employing many nested loops, and *intMM* performs a matrix multiplication on integer arrays. The *Tree* algorithm dynamically constructs a balanced binary tree with 5,000 nodes, providing a good indication of the operating system's speed at allocating data-storage memory. These integer-intensive looping routines are a good measure of a CPU's raw instruction-processing speed.

The **Stanford Recursion** test suite consists of *Towers*, *Queens*, *Quick Sort*, and *Bubble Sort* algorithms. The *Towers* algorithm solves the classic "towers of Hanoi" problem by employing a highly recursive, best-fit routine. The *Queens* algorithm solves the similar "eight queens" problem using a recursive approach as well. The *Quick Sort* and *Bubble Sort* algorithms recursively implement the standard sort routine found in C-language libraries. All algorithms use numeric-compare processes

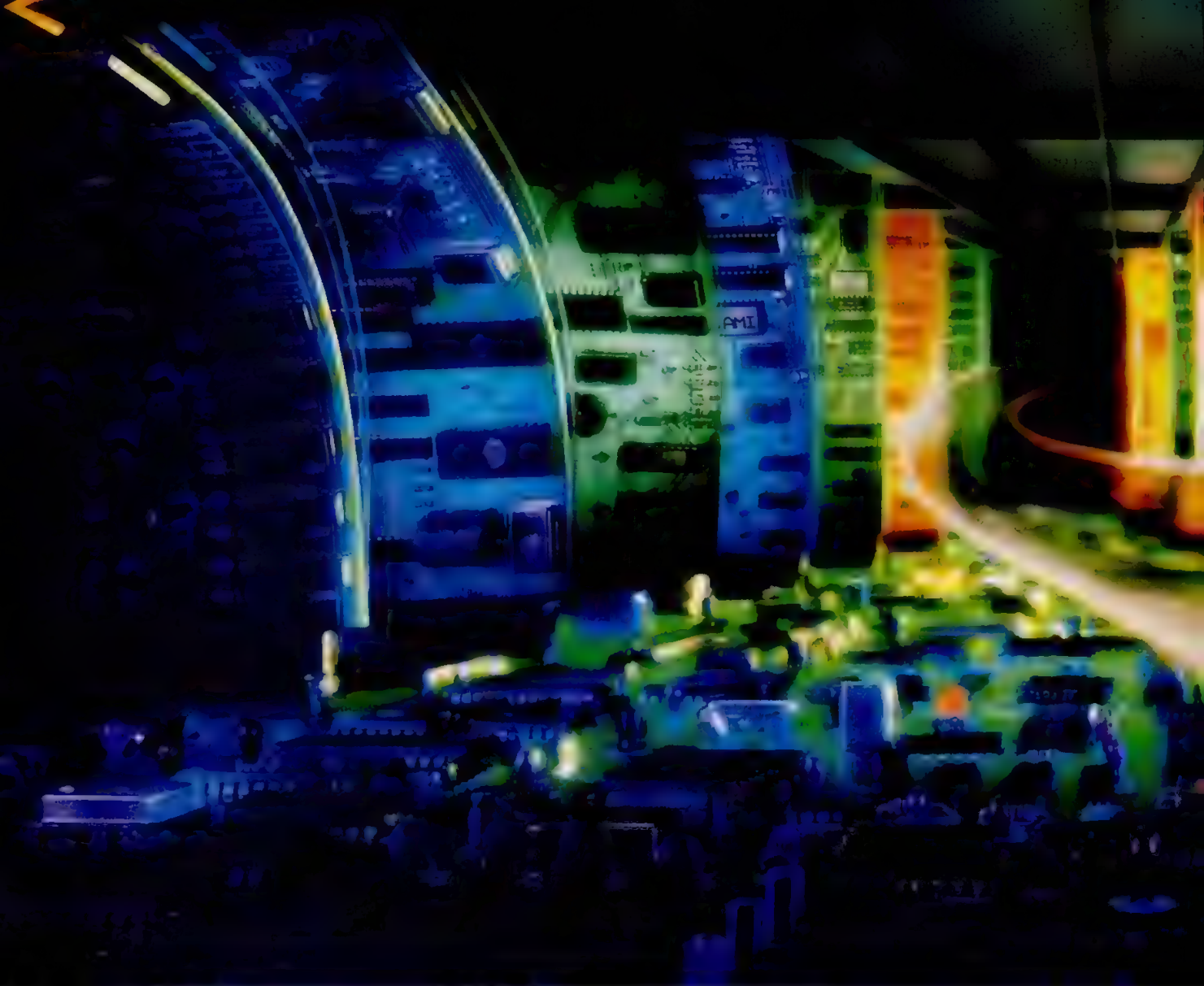
on simple data structures with no floating-point math involved. These small routines provide a good indication of a CPU's efficiency at handling the overhead and state changes involved in function calls, which are important parts of modern structured code.

We run 16-bit Windows emulation tests on both the NT and Unix workstations. On the **Windows NT** platforms, we use NT's native Windows emulation mode and run our WinApp 16 macro for Microsoft Excel for Windows. On select Unix platforms, we use Insignia Solutions' **SoftWindows** or Sun's **Wabi** as the mode of emulation and run the same Excel micro.

To help gauge real-world performance, we also run a number of native applications tests on the Windows NT- and Unix-based systems. We first looked for software compatible with all three NT processors and all six versions of Unix represented. At test time, only Pro Engineer (from Parametric Technology Corp.) and PV-Wave (from Visual Numerics) covered the RISC territory.

Pro Engineer is an advanced CAD/CAM application, and we run macros that cycle through the process of designing and building tools, from blueprints to die stage to finished manufacturing. The NT and Unix workstations all execute the same macros.

PV-Wave is a sophisticated graphical application for scientific analyses.



Better performance



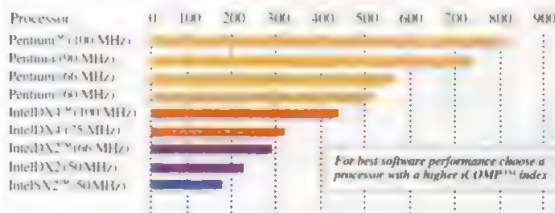
pentium
PROCESSOR

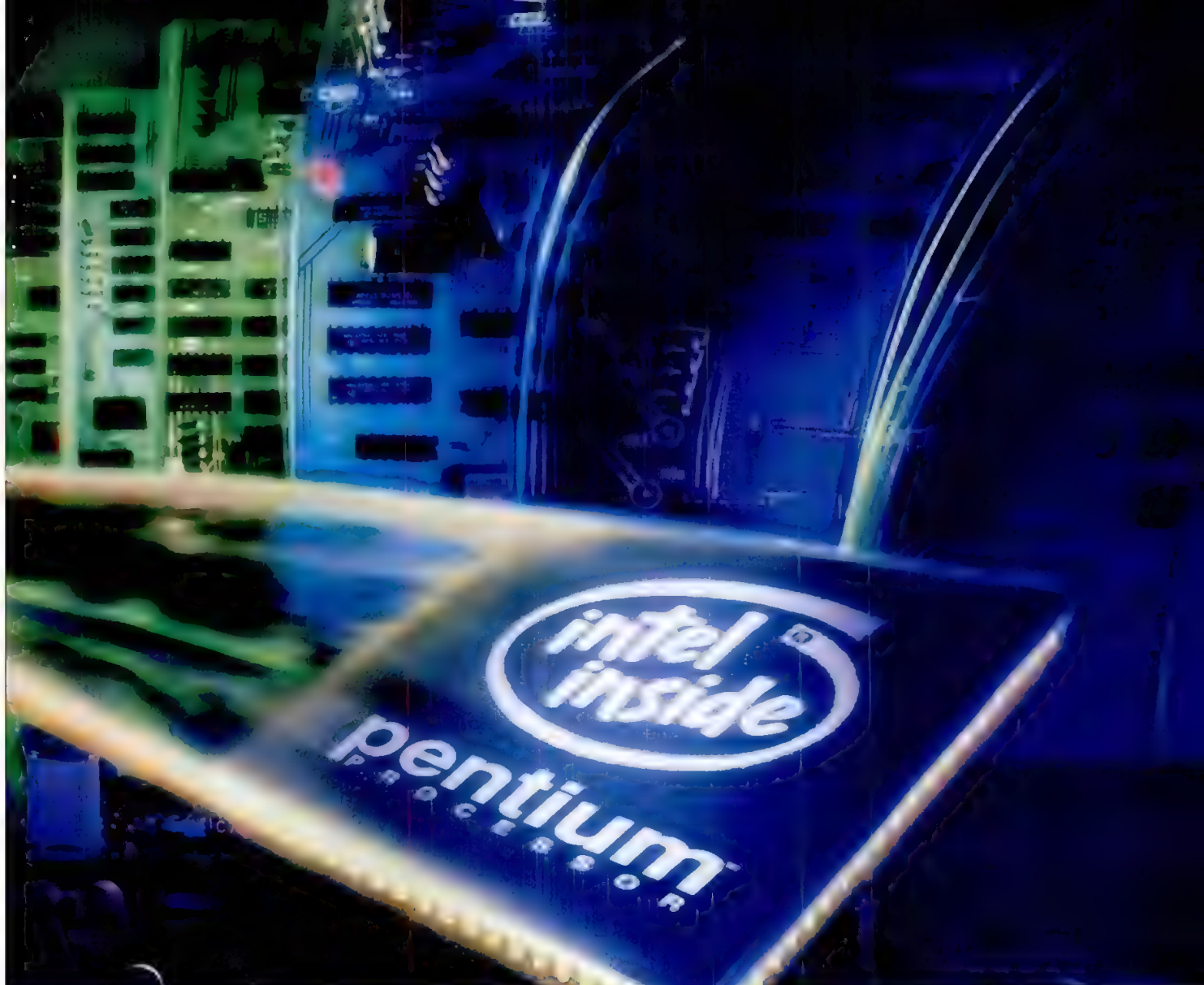
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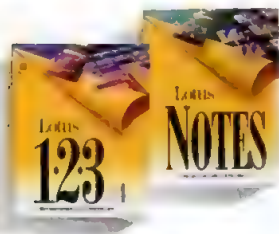
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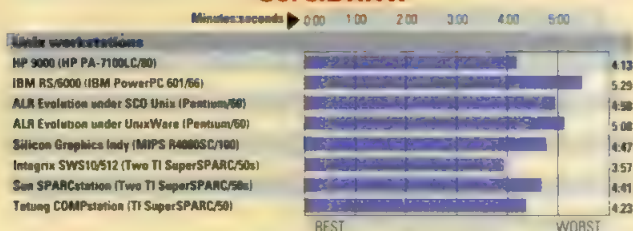


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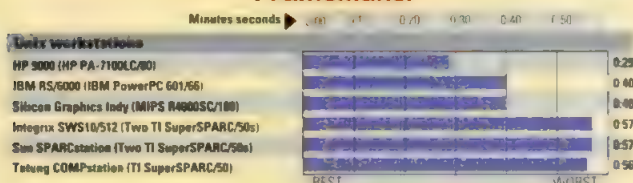


APPLICATIONS TESTS

CorelDRAW



FrameMaker



Pro Engineer



* Reported for comparison

We perform rendering and mathematical functions, including magnetic resonance imaging (MRI) and real-time photo decomposition. Because of a slightly different PV-Wave interface under NT, we were unable to run exactly the same functions on the NT workstations that we ran on the Unix workstations.

We were able to run several tests only on the Unix workstations. With Corel Corp.'s **CorelDRAW**, Version 3.0, an intricate drawing consisting of 683 separate objects is color-separated and printed to disk; other tasks are performed as well. Using Frame Technology's **FrameMaker**, Version 4.0, a professional desktop publishing application, we test each workstation's ability to manage complex documents by performing a series of functions within a 200-page document. The **AutoCAD 2-D** and **3-D** tests were developed by the AutoCAD Users Group of San Diego; these tests, which are run

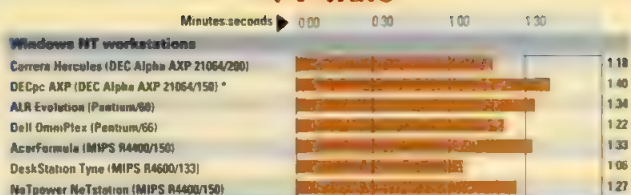
done, and it did have bright spots on the Khornerstone and single-precision Whetstone tests, but most of its scores were either average or below average. All of the NT-based RISC systems suffered a penalty in the double-precision Whetstone tests because their compilers weren't optimized.

The AcerFormula posted the lowest score on the 16-bit Excel Windows emulation test and also had one of the lowest scores on the Pro Engineer test; the system's scores on the PV-Wave and Picture Publisher tests, however, were

not too far off the mean. The lack of a truly strong performance showing on the Picture Publisher test was more likely due to the port of this application on MIPS-based NT systems in general than to a weakness in the system, since all MIPS NT entries suffered on this particular test.

Acer backs its systems with a standard one-year parts-and-labor warranty plus free on-site service for that year. It also has toll-free, 24-hour, 7-day technical support.—AY

PV-Wave



AutoCAD 2-D



AutoCAD 3-D



Picture Publisher



* Reported for comparison

with Autodesk's AutoCAD, Release 12, measure elapsed times for a variety of common CAD operations.

Just one other NT application was available at the time of testing across the Alpha, Intel, and MIPS platforms: MicroGrax's **Picture Publisher**, Version 4.0. With this application, we perform tests similar to those run on the Unix platforms using CorelDRAW.

DeskStation Technology Inc.

DeskStation Tyne v4633x

At \$8,479, the DeskStation Tyne v4633x RISC workstation combines top-notch performance with a price not too far above that of Intel-based workstations. Though you should consider the current scarcity of native applications for RISC-based Windows NT systems when thinking of a switch from the familiar Intel platform, the MIPS R4600-based Tyne does offer potent enticements. The 133-MHz R4600 CPU is slightly faster and provides a little more computing power than the MIPS R4400.

DeskStation Technology aims its systems at high-end power users interested in a familiar interface, high-end performance, and value. The company sells only Windows NT-based systems.

Our unit came equipped with 32MB of RAM (expandable to 256MB with 64MB SIMMs), 512K cache, two 525MB IDE drives, a single-speed Chinon CD-ROM, a Tyan VL-bus controller, an Appian video card with 2MB of VRAM and a 17-inch monitor plus an SMC Ethernet card. The tower case leaves plenty of room to expand

with four drive bays open, but slots are scarcer: only two ISA slots are free.

On many of our tests, the Tyne RISC system posted first-place scores among Windows NT machines. Naturally, the Intel-based systems were much faster in the 16-bit Excel test, but the Tyne did better than any other RISC-based NT machine and better than all but the top two Unix workstations—each selling for thousands more. On our applications tests, the unit had top scores among NT machines on both the Pro Engineer and PV-Wave tests, with scores in line with Unix systems in the latter. The only problem was a poor showing on the Picture Publisher test. Though other MIPS-based systems also did not fare well on this test, the Tyne was worst among them, perhaps due in part to its IDE disk subsystem (others had SCSI systems). It had the top scores under NT for Graphstones (the Appian card was a great help here), Khornerstones, and two of the Stanford tests but was bested by the Alpha-driven Carrera unit on the Dhrystone and floating-point portion of the Stanford tests. As in other NT RISC systems, the lack of optimized compilers hurt its performance on the double-precision Whetstone test.

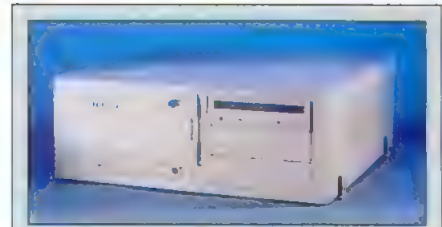
DeskStation offers a standard one-year warranty and a next-day on-site policy through General Electric. for an additional \$499 per year.—AY

NeTpower Inc.

NeTpower NeTstation 300

The MIPS R4400/150-equipped NeTpower NeTstation 300 has some performance benefits, but ultimately, at \$8,495, it may not offer the best combination of price and performance in the NT portion of this roundup.

NeTpower is a new company dedicated to the Windows NT operating system on the RISC platform, though it remains open to the possibility of using other processors. If its cases look familiar, that's because its workstations are manufactured by Acer. While they may look alike on the outside, there are differences on the motherboard: NeTpower works with Acer to customize the systems to its design specifications. NeTpower's present systems are aimed at the scientific and design workstation mar-



FACT FILE

NeTpower NeTstation 300

List price: \$8,495 **Processor/memory:** MIPS R4400/150 CPU, 32MB RAM, 128K external cache
Data storage: Seagate ST31200 1.05GB SCSI-2 hard disk, NCR 53C94 hard disk controller, PICA and ISA local buses, Sony 561 CD-ROM drive **Display:** NeTpower 93316-1 video controller with 1MB of VRAM, Acer 70761 17-inch color monitor with a 70-Hz refresh rate at 1,024-by-768 **Software:** Microsoft Windows NT.
NeTpower Inc., 545 Oakmead Pkwy., Sunnyvale, CA 94086; 800-801-0900.
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SUITABILITY TO TASK

Computational ability	GOOD
Expandability	GOOD
Engineering/scientific/CAD	GOOD
Graphics/publishing	GOOD

ket and at software developers.

The NeTstation came with 32MB of RAM (expandable to 128MB) and a fixed 128K cache—less than that of most systems in the roundup. It was also equipped with a double-speed Sony CD-ROM drive, a 1GB SCSI hard disk, a video card with 1MB of VRAM on a proprietary (PICA) local bus, a daughtercard with the SIMM banks and most I/O ports, integrated Ethernet, and a 17-inch monitor. The desktop case left some room for expansion with three drive bays free and two ISA slots open. NeTpower is also considering switching to a more widely accepted local-bus design for future RISC workstations.

The NeTstation didn't dazzle on our benchmark tests, but its performance remained steady throughout. Its scores on our applications tests were fair, though slightly below average under Picture Publisher and Pro Engineer. Like other NT MIPS-based systems, its results on the Stanford Floating-Point test and the Dhrystone test weren't as impressive as those of the Alpha-based Carrera, but it did well on the Khornerstone and Graphstone tests and held its own on the other two Stanford tests.

It had the best single-precision Whetstone score among the NT systems,

FACT FILE

DeskStation Tyne v4633x

List price: \$8,479
Processor/memory: MIPS R4600/133 CPU, 32MB RAM, 512K external cache **Data storage:** Two Quantum LS40AT 525MB IDE hard disks, Tyan S1345 VL-Bus IDE hard disk controller **Display:** Appian Renegade 1280V video controller card with 2MB of VRAM, ViewSonic 7E 17-inch monitor with a 76-Hz refresh rate at 1,280-by-1,024 **Software:** Microsoft Windows NT



SUITABILITY TO TASK

Computational ability	GOOD
Expandability	EXCELLENT
Engineering/scientific/CAD	GOOD
Graphics/publishing	EXCELLENT

DeskStation Technology Inc., 13,256 West 98th St., Lenexa, Kansas 66215, 800-793-3375; fax, 913-599-4024.

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though it, too, was penalized by a lack of optimized compilers in the double-precision tests. One low point was the result of the 16-bit Excel emulation test, where the NeTstation had one of the worst times of all NT systems.

The company backs its systems with a standard one-year parts and labor warranty with on-site service from BSC included.—AY

UNIX

Digital Equipment Corp.

DEC 3000 Model 300X AXP

Workstation

The heart of Digital's DEC 3000 Model 300X AXP Workstation is an Alpha 21064 CPU which, at 175 MHz, is one of the fastest general-purpose processors on the market. Unfortunately, the chip's capabilities are undermined by Digital's OSF/1, the company's version of the Unix operating system.

The DEC 3000 can run only OSF/1 and OpenVMS. Out of the five applications that made up our applications tests, OSF/1 supported only two: PV-Wave and Pro Engineer. This lack of OSF/1 support for relatively mainstream Unix applications can potentially spell trouble for Digital down the road. In order to find a market, the computer has to supply viable and flexible computing solutions, and that means mainstream as well as specialty applications.

The system, at \$13,691, is moderately priced, particularly when you consider its equipment level: 64MB RAM (expandable to 256MB), a 1GB SCSI-2 hard disk, a 19-inch monitor, and an integrated Digital HX video controller, all built around the Alpha 21064 CPU with 256K of external cache on top of the chip's 16K of internal cache. External CD-ROM and floppy disk drives were also shipped with the system.

At just over \$13,500, the DEC 3000 would be the system of choice if performance were the only point being considered. The system had the highest SPECfp92 score in the group, just about matching its claimed floating-point capability. Its SPECint92 score, while not quite as high, was respectable but not close to what Digital claimed it would be. This discrepancy may be due to the use of

► SUMMARY OF FEATURES

CONTINUES

RISC Workstations

List price (tested configuration) We report the prices for the workstations configured the way we tested them. Some vendors provide an estimated selling price to more accurately reflect what customers should expect to pay for the system.

A description of each high-end workstation's **processors** is followed by the CPU clock speed (in parentheses).

Internal cache refers to the cache built onto the processor. For most of the systems we tested, the processor cache is divided between data and instruction cache; other systems unify data and instruction cache.

Under **hard disks**, we indicate the number of hard disks included in the test system, along with their capacity and type.

Power supply (and number of connectors) We list the wattage of each power supply and the number of connectors for each. The number of connectors determines how many devices the workstation can power.

Bus architecture (primary, secondary) refers to the buses that connect the I/O slots to the CPU.

Processor upgrade path Processors can be seated in several different types of sockets, which determine a computer's CPU upgradability. These sockets can be standard, LIF (low insertion force), ZIF (zero insertion force), or TAZ (tool-activated ZIF); the upgrade chip can also be integrated onto a daughterboard.

We indicate the **BIOS version (or date)** for each system. The BIOS, which performs a computer's initial boot and test routines, may affect a unit's performance on our benchmark tests. Many Unix workstations, however, do not have BIOS programs that are directly comparable to those we find in the PC world.

Flash BIOS Flash ROM stores the BIOS code, replacing conventional ROM storage for this purpose. Unlike ROM, flash memory can handle both reads and writes, making the BIOS upgradable for future changes. Many Unix workstations do not have flash ROM.

Installable external RAM cache (per processor) We list the maximum amount of external RAM cache each processor can support.

Cache architecture In a direct-mapped cache architecture, each address in main memory is assigned to exactly one location in the cache. Each location in the cache, however, can accept data from many main memory addresses—though not from more than one at once. This many-to-one relationship between main memory and cache can sometimes lead to a data bottleneck. Some of the vendors address this problem by using a proprietary cache architecture, such as Unified secondary cache, TI SuperCache, or Harvard Architecture.

Cache write design For write-back cache, data that has been changed is written back to the cache; main memory is updated only when the cached data is replaced, thus minimizing delays. Write-through caches write updated data to both cache and main memory. Although write-through cache is relatively easy to implement, it can introduce delays when the processor must wait to complete writes to the slower main memory. Buffered write-through cache is like regular write-through cache except that the changes are stored in buffers until the system bus is free.

The **disk controller location** refers to the location of the disk controller circuitry. The controller can be located either on a card or on the system's motherboard.

CD-ROM drive For those tested systems that included a CD-ROM drive, we indicate the drive manufacturer and model.

The **display circuitry location** refers to the location of the video circuitry that directs video performance. The circuitry can be located either on a card or on the motherboard.

We indicate whether each system supports **audio** and **SCSI-2**.

We report each system's **maximum graphics support**. This may require the addition of a graphics card.

Network options include a built-in Ethernet or Token-Ring interface.

COVER STORY
RISC Workstations

► **S U M M A R Y O F F E A T U R E S**

RISC Workstations

Products listed in review order

■ = YES □ = NO

	Microsoft Windows NT						Unix	
	Hercules 200	ALR Evolution V/60	Dell OmniPlex 566	AcerFormala 4400	DeskStation Tyne v4633x	NeTpower NeTstation 300	DEC 3000 Model 300X AXP Workstation	HP 9000 Model 712/80i
Operating system	Windows NT 3.1	Windows NT 3.1	Windows NT 3.1	Windows NT 3.1	Windows NT 3.1	Windows NT 3.1	OSF/1 1.3	HP-UX 9.03
List price (tested configuration)	\$9,995	\$8,570	\$7,007	\$8,179	\$8,479	\$8,495	\$13,691	\$14,115
Processors	One DEC Alpha AXP 21064 (200 MHz)	One Intel Pentium (60 MHz)	One Intel Pentium (66 MHz)	One MIPS R4400 (150 MHz)	One MIPS R4600 (133 MHz)	One MIPS R4400 (150 MHz)	One DEC Alpha AXP 21064 (175 MHz)	One HP PA-7100LC (80 MHz)
Internal cache	16K	16K	16K	32K	32K	32K	16K	None
Hard disks	One 426MB SCSI-2	Two 540MB IDE	One 1GB SCSI-2	One 1GB SCSI-2	Two 525MB IDE	One 1GB SCSI	One 1.05GB SCSI-2	One 1.05GB SCSI-2
Case style	Tower	Desktop	Desktop	Desktop	Tower	Desktop	Desktop	Desktop
Power supply (and number of connectors)	254W (5)	200W (4)	224W (5)	200W (5)	250W (7)	200W (4)	260W (3)	70W (2)
Warranty	3 years	5 years parts, 15 months labor	1 year	1 year	1 year	1 year	1 year	1 year
On-site service charge	N/A	\$9.95 (1 year)	Included (1 year)	Included (1 year)	\$499.00 (1 year)	Included (1 year)	\$1,944.00 (1 year)	Included (1 year)
Processor and Memory								
Bus architecture (primary, secondary)	EISA	ISA, VL-Bus	EISA, PCI	ISA, PICA	ISA, VL-Bus	ISA, PICA	TURBOchannel	GSC
Motherboard manufacturer	Camera/Digital	ALR	Dell	Acer	DeskStation	NeTpower	Digital	HP
Chip set manufacturer	Digital	OPTi	Intel	Acer	DeskStation	Acer/MIPS	Digital	HP
Processor upgrade path	TAZ	None	None	LIF	None	Standard	None	None
BIOS version (or date)	Digital/Microsoft 2.07	Phoenix 1.02.02M	Phoenix (1/24/94)	Acer 1.0	DeskStation (1/1/94)	Acer 1.0	Digital 3.1	HP VX 9.03
Flash BIOS/16550 UART support	□ ■	■ □	■ ■	□ □	□ □	□ □	■ □	■ ■
Installable system RAM	32MB–256MB	8MB–128MB	8MB–192MB	16MB–128MB	16MB–256MB	32MB–128MB	32MB–256MB	16MB–128MB
Type of SIMMs supported	72-pin	72-pin	72-pin	72-pin	72-pin	72-pin	72-pin	72-pin
Installable external RAM cache (per processor)	512K	256K	256K	128K	0–2MB	128K	256K	256K
Cache architecture	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
Cache write design	Write-back	Write-back	Write-back	Write-through	Unified write-through	Write-through	Write-through	Write-back and write-through
Components								
Available hard disk sizes	426MB–4GB	210MB–1.37GB	330MB–2GB	520MB–1GB	200MB–8GB	240MB–2GB	53MB–4.2GB	260MB–1.05GB
Disk controller location	Motherboard	VL-Bus card	Motherboard (PCI)	PICA bus card	VL-Bus card	Motherboard	Motherboard	Motherboard
Accessible drive bays	4	3	3	4	4	4	1	None
Internal drive bays	1	3	2	2	2	2	1	2
Floppy disk drives	2 88MB	1.44MB	Dual 1.44MB/1.2MB	1.44MB	1.44MB	1.44MB	2 88MB	1.44MB
CD-ROM drive	Sony CDU-541	Plextor DM-3028	Toshiba XM-3401B	Toshiba XM-3401B	Chinon CDS-535	Sony CDU-561	DEC RRD-42	Toshiba XM-3401B
Expansion slots (number and type)	Six EISA	Three ISA, three VL-Bus	Three EISA, two PCI	Three ISA, two PICA	Four ISA, two VL-Bus	Three ISA, two PICA	Two TURBOchannel	Two GSC
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1	0, 1, 1	1, 1, 1
Display circuitry location	EISA card	VL-Bus card	Motherboard (PCI)	PICA bus card	VL-Bus card	PICA bus card	Motherboard	Motherboard
Video chip set manufacturer	Compaq	Matrox	ATI	S3	Appian	S3	Digital	HP
Video RAM	2MB	2MB	2MB	2MB	2MB	2MB	2MB	2MB
Miscellaneous								
Audio	□	□	□	□	□	□	■	■
SCSI-2	■	□	■	■	■	■	■	■
Maximum graphics support	24-bit	24-bit	24-bit	64-bit	24-bit	24-bit	24-bit	8-bit
Monitor sizes available (diagonal, in inches)	17, 20	14, 15, 17	14, 21	14, 15, 17	15, 17, 20, 21	14, 17, 19, 21	17, 19	15, 17, 19
Network options	Ethernet	Ethernet	Ethernet, Token-Ring	Ethernet	Ethernet, Token-Ring	Ethernet, Token-Ring	Ethernet*	Ethernet

N/A—Not applicable: The product does not have this feature. * The system comes configured with the Ethernet network interface.
ALR—Advanced Logic Research Inc., ATI—ATI Technologies Inc., GSC—General Systems Connect, SGI—Silicon Graphics Inc.

COVER STORY

RISC Workstations

PC MAGAZINE
EDITORS' CHOICE

RISC System/6000 POWERstation 25T	ALR Evolution V/60	Silicon Graphics Indy	Integrax SWS10/512 50MHz SPARCstation 10	SPARCstation 20 Model 502	Super COMPstation 10 Model 51
AIX 3.2.5	SCO Unix 3.0.0	Inix 5.1.2	Solaris 2.3	Solaris 2.3	Solaris 2.3
\$15,525	\$6,599	\$21,195	\$19,995	\$18,295	\$17,280
One IBM PowerPC 601 (66 MHz)	One Intel Pentium (80 MHz)	One MIPS R4000SC (100 MHz)	One Sun SuperSPARC (50 MHz)	Two Sun SuperSPARC+ (50 MHz)	One Sun SuperSPARC (50 MHz)
32K	16K	16K	36K	36K	36K
One 1GB SCSI-2	One 1.05GB SCSI-2	One 1GB SCSI 2	One 1.05GB SCSI-2	One 1.05GB SCSI 2	One 1.05GB SCSI 2
Desktop	Desktop	Desktop	Desktop	Desktop	Desktop
140W (2)	200W (4)	170W (2)	160W (4)	150W (1)	140W (3)
1 year	5 years parts, 15 months labor	1 year	1 year	1 year	1 year
Cost varies	\$9.95 (1 year)	\$820.00 (1 year)	N/A	\$1,440.00 (1 year)	\$1,800.00 (1 year)
MCA	ISA, VL-Bus	Proprietary GIO 64 bus	MBus, SBus	MBus, SBus	MBus, SBus
IBM	ALR	SGI	Integrax	Sun	Tatung
IBM	OPTi	SGI	LSI Logic	Texas Instruments	LSI Logic
None	None	CPU module upgrade	Daughterboard	Daughterboard	Daughterboard
N/A	Phoenix 1.02.02M	N/A	Sun 2.11	N/A	Tatung Open Boot PROM 2.12
N/A	■ []	N/A	■ []	N/A	□ []
16MB-256MB	8MB-128MB	16MB-256MB	16MB-512MB	32MB-512MB	16MB-512MB
72-pin	72-pin	72-pin	200-pin	200-pin	200-pin
N/A	256K	Up to 1MB	Up to 1MB	Up to 1MB	Up to 1MB
N/A	Direct-mapped	Unified secondary cache	TI SuperCache	Harvard Architecture	Direct-mapped
N/A	Write-back	Write-back	Write-back	Write-back	Write-back
200MB-2GB	210MB-1.37GB	535MB-2GB	424MB-2GB	535MB-2GB	520MB-2GB
Motherboard	ISA card	Motherboard	Motherboard	Motherboard	Motherboard
1	3	1	1	2	1
1	3	0	0	2	2
2.88MB	1.44MB	1.44MB	1.44MB	None	1.44MB
IBM 7210-001	Plexor DM-3028	None	Sony/Sun X 559A/C3	None	None
Two MCA	Three ISA, three VL-Bus	Two GIO 32	Two MBus, four SBus	Two MBus, four SBus, two VSIMM	Two MBus, four SBus
1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1
Proprietary local-bus card	VL-Bus card	Motherboard	SBus card	Motherboard	Motherboard
IBM	ATI	SGI	LSI Logic	Sun	LSI Logic
3MB	2MB	2MB	4MB	4MB	1MB
□	□	■	■	■	■
8-bit	24-bit	24-bit	24-bit	32-bit	32-bit
16, 17, 19, 23	14, 15, 17	14, 16, 19	16, 19, 20, 21	17, 20	15, 17, 19
Ethernet*	Ethernet	Ethernet	Ethernet*	Ethernet*	Ethernet*



FACT FILE

DEC 3000 Model 300X AXP Workstation

List price: \$13,691 **Processor/memory:** DEC Alpha 21064/175 CPU, 64MB RAM, 256K external cache

Data storage: Digital RZ-26 1.05GB SCSI-2 hard disk, integrated SCSI-2 hard disk controller, DEC RRD-42 CD-ROM drive **Display:** Integrated Digital HX video controller with 2MB of VRAM, Digital VRT 19 19-inch monitor with a 72-Hz refresh rate at 1,280-by-1,024

Software: DEC OSF/1 AXP Version 1.3a

SUITABILITY TO TASK

Digital Equipment Corp., 146 Main St., Maynard, MA 01754, 800-344-4825, fax-back service, 800-723-4431
459 On reader service card

Computational ability	EXCELLENT
Expandability	Good
Engineering/scientific/CAD	Good
Graphics/publishing	Good

a different compiler for our benchmark test. On the single- and double-precision Whetstone tests and on the Dhrystone test, the DEC 3000 posted top scores.

The unit's graphics accelerator also helped it to post Xmark and Graphstone scores that were well within average. On the two applications we did run for our tests, this unit was competitive.

By manufacturing and selling different workstations that run on a variety of operating systems, Digital is covering all the bases. But it may be spreading itself too thin: in the Unix arena, lack of software support for OSF/1 alone will make it harder for Digital to gain any market share.—William P. Flanagan

Hewlett-Packard Co.

HP 9000 Model 712/80i

Hewlett-Packard Co.'s \$14,115 HP 9000 Model 712/80i offers above-average graphics capabilities, high overall performance, and expandability at a midrange price for a high-end workstation. The system is the latest in a long line of high-performance systems from Hewlett-Packard, which is one of the market leaders in workstation sales, second only to Sun Microsystems.

Hewlett-Packard has a large installed



FACT FILE

HP 9000 Model 712/80i

List price: \$14,115. **Processor/memory:** HP PA-7100LC/80 CPU, 64MB RAM, 256K external cache. **Data storage:** Micropolis Model 2112 1.05GB SCSI-2 hard disk, integrated NCR C7-10 GSC local-bus hard disk controller with 256MB of cache, Toshiba 3401 CD-ROM drive. **Display:** Integrated HP GVI accelerator video controller with 2MB of VRAM, Sony HP A2094-A 19-inch monitor with a 72-Hz refresh rate at 1,280-by-1,024. **Software:** HP-UX 9.03

SUITABILITY TO TASK

Computational ability	GOOD
Expandability	FAIR
Engineering/scientific/CAD	EXCELLENT
Graphics/publishing	EXCELLENT

Hewlett-Packard Co.,
Direct Marketing
Organization, P.O.
Box 58059, Santa
Clara, CA 95051;
800-637-7740; fax,
800-333-1917.
460 On reader service card

base in scientific and engineering circles but is clearly making inroads in financial and commercial industries, which were once the sole territory of Sun Microsystems. Financial companies reevaluating their platforms may indeed consider Hewlett-Packard an alternative to Sun Microsystems.

The system's \$14,115 price tag is competitive with the DEC 3000 Model 300X AXP Workstation and IBM's RISC System/6000 POWERstation 25T and considerably lower than the SuperSPARC-based machines and the Silicon Graphics Indy. For that price, the system was configured with HP-UX 9.03 and one HP PA-7100LC chip running at 80 MHz but with no internal cache; 256K of external combined instruction and data cache augments the workstation. The configuration of the HP 9000 was suitably high-end: It included 64MB of RAM, a 1.05GB Micropolis hard disk, and a 19-inch monitor with an HP GVI video controller.

This system's performance on our tests was solidly above average. The SPECint92 score, while average for the Unix group, was lower than what HP claimed. HP said, however, that the claimed SPECmark scores were produced with compilers that weren't available to us for this test but will be generally available by the time you read

this. The unit's SPECfp92 score of 72.3 was average as well.

The HP 9000 posted Xmark and Graphstone scores that were second only to those of the RS/6000. The unit's single-precision Whetstone score was also above average, but the double-precision Whetstone and the Dhrystone scores were just below average. On our applications tests, the HP 9000 was on a par with the other systems and among the best in CorelDRAW, FrameMaker, and Pro Engineer.

A large base of third-party software suppliers combined with a reputation for high performance and competitive pricing makes HP a bigger player than ever in the high-stakes Unix game.—WPF

IBM Corp.

RISC System/6000 POWERstation 25T

The \$15,525 RISC System/6000 POWERstation 25T workstation, from IBM, based on the new PowerPC processor jointly developed by Apple, IBM, and Motorola, occupies a spot in the middle of IBM's RS/6000 line. The remainder of units in this line continue to use IBM's POWER, POWER2, and RSC architectures. With the PowerPC processor, buyers will be able to choose between AIX 3.2.5 (IBM's version of Unix) and eventually Sun Microsystems's Solaris.

Utilizing a PowerPC 601 processor running at 66 MHz with 32K of unified internal cache, the RS/6000 is IBM's first implementation of the new PowerPC architecture. Our test system was configured with 64MB of system memory (expandable to a total of 256MB) and a 1GB hard disk. The graphics subsystem was made up of the new GXT150 graphics accelerator card with 3MB of video RAM and a 17-inch POWERdisplay monitor (19-inch and 23-inch monitors are also available from IBM).

This system's benchmark test performance lived up to expectations as a general workstation platform. A SPECfp92 score of 74.2 and a SPECint92 score of 62.6 were close to the figures IBM had claimed and well within the range of the other tested units' scores. The system's Dhrystone score was average as well, but the single- and double-precision Whetstone scores were



FACT FILE

RISC System/6000 POWERstation 25T

List price: \$15,525. **Processor/memory:** IBM PowerPC 601/66 CPU, 64MB RAM. **Data storage:** IBM EC844857 1GB SCSI-2 hard disk, integrated local-bus disk controller, IBM 7210-001 CD-ROM drive. **Display:** IBM GXT150 video controller with 3MB of VRAM, 17-inch IBM POWERdisplay 17 monitor with a 77-Hz refresh rate at 1,280-by-1,024. **Software:** AIX 3.2.5, AIXwindows.

SUITABILITY TO TASK

Computational ability	EXCELLENT
Expandability	GOOD
Engineering/scientific/CAD	EXCELLENT
Graphics/publishing	EXCELLENT

IBM Corp., Old
Orchard Rd., Armonk,
NY 10504, 800-426-
2255; fax, 800-426-
4329.
461 On reader service card

slightly below average. On our Stanford tests, the RS/6000 excelled at all concurrent process levels on the integer portion of the tests, far outpacing all of its Unix workstation competition and most of the tested Windows NT units as well.

The RS/6000 really excelled at the low-level graphics tests. The system posted Xmark and Graphstone scores that were considerably higher than those of the other workstations in this roundup. All the Unix workstations were competitive on our applications tests, and the RS/6000 was no different. For the most part, it posted average scores in each application.

The RS/6000 is a solid workstation at a comparatively low price. Many people feel IBM, Motorola, and Apple are attempting to take on Intel with the PowerPC chip, but this workstation is an indication that IBM isn't going to stop there. Unix workstation manufacturers had better take notice.

Future versions of the PowerPC chip, including the 604 and the 620, will run at higher speeds and will probably turn up in future IBM machines. The attractive price, good performance, and the promised ability of upcoming PowerPC chips to run a number of advanced operating systems bode well for the RS/6000 series. IBM also backs this system with a one-year warranty.—WPF

Advanced Logic Research Inc.

ALR Evolution V/60

In a DOS and Windows environment, the \$6,599 Pentium-based ALR Evolution V/60 has proven itself to be a well-designed system. Unfortunately, as a Unix workstation, the Evolution, while in the ballpark, lags behind the RISC workstations in this review.

This is basically the same unit reviewed in "Unleashing the Power of Pentium," April 12, 1994, with a memory upgrade and, because of the choice of operating system, a relative downgrade in the video adapter. This standard desktop unit came configured with 32MB of RAM (expandable to 128MB) and a standard 256K secondary cache. The video subsystem comprised an ATI Mach32-based video card and a 17-inch monitor. We tested the system under SCO Unix 3.2 and UnixWare 1.1.

The Pentium processor provides an entree into the Unix arena, but be aware that although the price tag is attractive, the performance is not quite on a par with that of workstations from leading Unix vendors such as Hewlett-Packard and Sun Microsystems. On our benchmark tests, the Evo-

lution toughed it out among some stiff competition. Running under UnixWare and SCO, it had a SPECint92 score that was competitive and even higher than that of the DEC 3000 Model 300AXP Workstation and the Silicon Graphics Indy.

Not surprisingly, the SPECfp92 score was far below most systems' scores and under SCO was less than half the score posted by Digital Equipment Corp.'s entry. On the Dhrystone tests, ALR's Evolution was one of the top-performing systems, and under UnixWare, it had above-average scores on the single- and double-precision Whetstone tests.

Because of its Mach32-based video subsystem, the Evolution posted Graphstone and Xmark scores that were well below average. Advanced Logic Research sent an ATI video board, because SCO does not support the Matrox board. CorelDRAW was the only software package that we could run for our applications tests, because the other packages were either written for lower versions of the operating system or not available at all. Using CorelDRAW, the unit was a little below average but competitive.

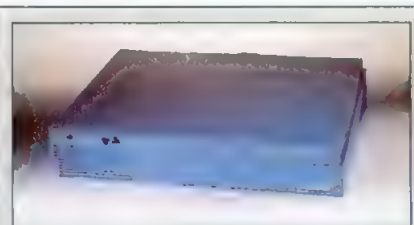
Overall, you cannot yet expect the performance from a Pentium-based system under Unix that you would get from RISC-based workstations running the versions of Unix that they were designed for. These RISC-based workstations still have a big advantage over Pentium-based systems in 3-D graphics and engineering applications. —WPF

Silicon Graphics Inc.

Silicon Graphics Indy

Silicon Graphics has made a name for itself producing high-performance visual computing systems for customers unconcerned with price. With the \$21,195 Indy, SGI has taken the next step in desktop multimedia. By combining the already-legendary graphics capabilities of the Indigo family with a digital color video camera, SGI is offering one-stop shopping to users who need a high-end graphics workstation for a creative multimedia environment or are interested in exploring videoconferencing.

Indy is the entry-level system in SGI's Indigo line. In addition to the camera, the



FACT FILE

Silicon Graphics Indy

List price: \$21,195 **Processor/memory:** MIPS R4000SC/100 CPU, 64MB RAM, 1MB external cache
Data storage: Seagate ST31200N 1GB SCSI-2 hard disk, Western Digital 3393 integrated controller **Display:** SGI integrated video controller with 2MB of VRAM, Sony GDM17D11 16-inch monitor with a 60-Hz refresh rate at 1,280-by-1,024 **Software:** IRIX 5.1 included with IndigoMagic User.

Silicon Graphics Inc.,
2011 N. Shoreline
Blvd., Mountain
View, CA 94043;
800-800-7441.
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SUITABILITY TO TASK

Computational ability	GOOD
Expandability	GOOD
Engineering/scientific/CAD	GOOD
Graphics/publishing	GOOD

Indy came configured running IRIX 5.1 and with 64MB of RAM, a 1GB Seagate hard disk, true 24-bit color graphics (a \$3,000 option included in our test system), and a 16-inch monitor. The system is built around the R4000SC processor running at 100 MHz with 16K internal cache and 1MB external cache. The features built into this machine are impressive: standard audio/video ports, Graphics In/Out expansion for professional video options or additional networking interfaces, and ISDN support.

Although the Indigo line has historically been a family of high-end graphics workstations, the Indy posted average Graphstone and Xmark scores. In our tests last year, the Silicon Graphics Iris Indigo R4000 XZ dominated our low-level graphics tests over units from Hewlett-Packard and IBM. This year the tables have turned with IBM clearly becoming a force in producing high-end graphics systems.

While there is some difference between the SPECint92 score and SGI's claims, we did get good agreement in the SPECfp92 score. The Indy's Dhrystone score was below average. On the single-precision Whetstone test, the Indy's score was below average, but it redeemed itself on the double-precision Whetstone test. Scores on our applications tests were equally mixed. The Indy performed well using FrameMaker and PV-Wave but was



FACT FILE

ALR Evolution V/60

List price: \$6,599 **Processor/memory:** Intel Pentium/60 CPU, 32MB RAM, 256K external cache
Data storage: Conner CFP-1060S 1.05GB SCSI hard disk, DPT 2022 hard disk controller with 4MB of cache, Texel 3028 CD-ROM drive **Display:** ATI Mach32 video controller with 2MB of VRAM, ALR FlexVIEW 4xNI 17-inch monitor with a 72-Hz refresh rate at 1,280-by-1,024 **Software:** SCO Unix 3.0.0, ODT 3.0

Advanced Logic
Research Inc., 9401
Jeronimo, Irving, CA
92718; 800-444-
4257, 714-581-6770;
fax, 714-581-9240.
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SUITABILITY TO TASK

Computational ability	GOOD
Expandability	EXCELLENT
Engineering/scientific/CAD	FAIR
Graphics/publishing	FAIR

a little below average using AutoCAD, CorelDRAW, and Pro Engineer.

The Indigo line has given SGI a niche market based in creative industries like entertainment and design. This niche may get smaller as companies such as HP and IBM lower prices and develop better graphics capabilities. To counter, SGI must make the Indigo line more appealing to Unix users in other industries.—WPF

Integrax Inc.

Integrax SWS10/512 50MHz SPARCstation 10

Initially, the idea of going to Integrax for a workstation based on Sun Microsystems' 50-MHz SuperSPARC processor might seem roundabout. With the Integrax SWS10/512 50MHz SPARCstation 10, however, Integrax makes a case for itself in three crucial areas: price, performance, and support.

Integrax started out as a manufacturer of Sun-compatible peripherals before it began building and selling complete workstations. Integrax sees this as an added advantage for customers, since it allows them to buy and upgrade peripherals, such as high-end graphics cards, at the initial point of purchase.

The \$19,995 Integrax SWS10/512 came configured with the Solaris 2.3 operating system, 64MB of RAM, a 1.05GB SCSI-2 hard disk, and a pair of 50-MHz SuperSPARC processors, each with 1MB of external cache and 36K of internal cache. The only clear physical difference between this system and the other SPARC-based systems in this roundup is the Integrax TGX220 graphics card. The individual CPU cards and the power supply are manufactured by Sun, and the motherboards of the parent and clone systems share many of the same chip sets. The result is a two-processor, general-purpose workstation with an emphasis on value.

The Integrax SWS10/512 surprisingly posted slightly better test scores than the other two SuperSPARC-based systems in this roundup. The unit's SPECfp92 score falls in line with Integrax's claims. The machine's SPECint92 score, however, was substantially higher than what was claimed and was the best among these



► FACT FILE

Integrax SWS10/512 50MHz SPARCstation 10

List price: \$19,995 **Processor/memory:** Two Sun SuperSPARC/50 CPUs, 64MB RAM, 1MB external cache for each CPU **Data storage:** Seagate ST-11200 1.05GB SCSI-2 hard disk, integrated hard disk controller, Sony/Sun X559A/C3 CD-ROM drive **Display:** Integrax TGX220 video controller card with 4MB of VRAM, Sony 1632 17-inch monitor with a 66-Hz refresh rate at 1,152-by-900 **Software:** Solaris 2.3.

Integrax Inc., 1200
Lawrence Drive,
#150, Newbury Park,
CA 91320, 800-300-
8288, 805-375-1055;
fax, 805-375-2799.
464 Unix reader service card

SUITABILITY TO TASK

Computational ability	EXCELLENT
Expandability	EXCELLENT
Engineering/scientific/CAD	EXCELLENT
Graphics/publishing	GOOD

Unix workstations (likely the result of an advanced compiler). On the Dhrystone test and the single- and double-precision Whetstone tests, the system's scores were a little below average but competitive.

On our applications tests, the Integrax SWS10/512 had an uneven showing: It posted top scores in CorelDRAW, Pro Engineer, and the 3-D portion of our AutoCAD test but low scores using FrameMaker and PV-Wave. Because of Integrax's TGX220 graphics card, the system's Xmark score and Graphstone score were significantly higher than those of the other SuperSPARC-based entries.

Integrax must fight an uphill battle in order to draw customers away from Sun. Integrax offers a one-year warranty and a 90-day money-back guarantee. In terms of future CPU and operating-system upgrades, however, Sun will lead the way.—WPF

Sun Microsystems Inc.

SPARCstation 20 Model 502

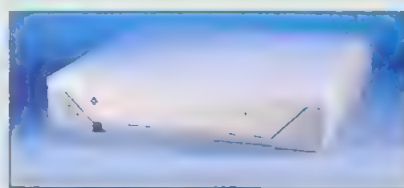
Sun Microsystems is currently the market leader when it comes to Unix-based workstations. But Sun will face some stiff competition in the coming year as much from vendors that use other RISC proces-

sors as from companies selling comparable SuperSPARC-based machines.

To fend off this new wave of challengers, Sun has announced the SPARCstation 20 Model 502. With a configuration similar to the Integrax SWS10/512 50MHz SPARCstation 10, the SPARCstation came with a pair of SuperSPARC+ 50-MHz CPUs, 64MB of RAM, a 1.05GB hard disk, and Solaris 2.3. Surprisingly enough, the SPARCstation, at \$18,295, is cheaper than the Integrax SWS10/512, but in many cases the SPARCstation was overpowered by the clone competition.

What is most surprising is that this multiprocessing system was slower than the Integrax SWS10/512, which was also equipped with two processors. Even Tatung Science & Technology's single-processor Super COMPstation 10 Model 51 performed better on a number of tests. There were few tests where the SPARCstation was clearly faster than the Integrax SWS10/512, but for most tests, the SPARCstation ranged from the same performance to 10 percent slower than the Integrax SWS10/512. The SPARCstation finished behind its SuperSPARC-powered brethren on the SPECint92 and SPECfp92 tests, and its Xmark score was bested by all in this group except the ALR Evolution V/60.

This SPARCstation's scores on our applications tests were better than those of



► FACT FILE

SPARCstation 20 Model 502

List price: \$18,295 **Processor/memory:** Two Sun SuperSPARC+/50 CPUs, 64MB RAM **Data storage:** Seagate ST31200WC 1.05GB SCSI-2 hard disk, integrated local-bus hard disk controller with 256K of cache **Display:** Integrated SPARCstation SX graphics chip with 4MB of VRAM, Sony Trinitron 16-inch monitor with a 76-Hz refresh rate at 1,280-by-1,024 **Software:** Solaris 2.3, OpenWindows 3.2

Sun Microsystems
Inc., 2550 Garcia
Ave., Mountain
View, CA 94043-
1100; 800-426-5321,
ext. 795.
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SUITABILITY TO TASK

Computational ability	GOOD
Expandability	EXCELLENT
Engineering/scientific/CAD	EXCELLENT
Graphics/publishing	FAIR



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OL400e

OL410e



the Integrix SWS10/512 and the COMPstation, but all of these systems' scores were close together. While the SPARCstation has a new, lower-cost architecture, it is clearly not a faster one.

Sun recently announced a 60-MHz version of the SuperSPARC and is promising an 80-MHz-plus version before the end of the year. This will bring its chip closer to the speed rating of other RISC chips. It couldn't come at a better time, since companies such as HP and IBM are making inroads into Sun's Unix base in the commercial and financial industries.

As long as Sun continues to upgrade and develop Unix solutions, it will continue to have a large user base. A company using the SPARCstation would be hard-pressed to justify a radical change as long as its needs are still being met.—WPF

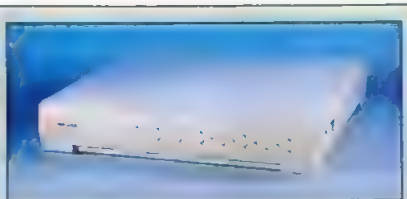
Tatung Science & Technology Inc.

Super COMPstation 10 Model 51

The Super COMPstation 10 Model 51, from Tatung Science & Technology, is this story's third system based on Sun Microsystems' SuperSPARC family. While the performance of this machine lagged slightly behind that of the Integrix SWS10/512 50MHz SPARCstation 10, it was configured with only one processor. Adding a second processor may even the playing field in terms of performance, but it would also push up the system's \$17,930 price tag.

With the exception of the single processor and the graphics card, the COMPstation, which came in a pizza-box-style case, had a similar but not identical configuration as the other SPARC-based systems in this review: It came with Solaris 2.3, 1MB of external processor cache (in addition to the CPU's internal 36K), 64MB of RAM, a Seagate 1.05GB hard disk, and a 3.5-inch floppy disk drive.

The overall performance of the COMPstation was solid. Even with a single CPU, its scores were competitive with the two-CPU SuperSPARC units. This unit's SPECfp92 score was comparable with that of the two-CPU Integrix SWS10/512 and, surprisingly enough, was noticeably better than that of the two-CPU SPARCstation 20 Model 502. Its SPECint92 score was in line with both SuperSPARC-based systems' scores.



► FACT FILE

Super COMPstation 10 Model 51

List price: \$17,280 **Processor/memory:** Sun SuperSPARC/50 CPU, 64MB RAM, 1MB external cache **Data storage:** Seagate ST-31200N 1.05GB SCSI-2 hard disk, integrated SCSI-2 hard disk controller **Display:** Integrated Tatung 5000GX video controller with 1MB of VRAM, Tatung CM-17MBR 17-inch monitor with a 66-Hz refresh rate at 1,152-by-900 **Software:** Solaris 2.3, OpenWindow 3.3, X Window (X11R5/Motif 1.21)

Tatung Science & Technology Inc.,
1840 McCarthy
Blvd., Milpitas, CA
95035; 800-659-
5902, 408-383-0988;
fax, 408-383-0886.

466 On reader service card

SUITABILITY TO TASK

Computational ability	EXCELLENT
Expandability	GOOD
Engineering/scientific/CAD	EXCELLENT
Graphics/publishing	GOOD

The COMPstation's video system, which uses a GX graphics adapter, did not perform nearly as well as that of the Integrix SWS10/512, but the COMPstation did post a marginally better Xmark score than Sun's SPARCstation, which uses the same card. With strong scores in AutoCAD, CorelDRAW, and Pro Engineer and a poor showing in FrameMaker, the COMPstation mirrored the performance of the other systems running Solaris 2.3.

According to Tatung, the COMPstation is comparable feature for feature to the SPARCstation. For \$1,000 to \$2,500 more, you can go to Integrix or Sun and get a two-processor SuperSPARC system. The main question remains as to which company will give you the best support for your Solaris workstation.

Tatung prides itself on offering a wide array of options for storage, monitors, and other peripherals. But Tatung, like Integrix, will be looking to Sun to pave the way for processor and operating-system upgrades.

On the whole, Tatung's COMPstation was a solid if unspectacular performer, ranking in the middle of the workstation pack on most tests; but the unit is a little expensive when compared with similarly performing machines.—WPF

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Computers

RISC SERVERS

One Size *does not* Fit All



Take a couple of IBM mainframes, a dozen Hewlett-Packard RISC-based application servers, throw in several hundred 486DX2/66 PCs of various origin, and what have you got? Just a snapshot of the diverse computing environment at Chevron Corp.—one of the world's largest oil companies. The jigsaw-puzzle nature of this network, in which vastly different computers must mesh and work cooperatively, is becoming increasingly typical of large international firms.

Companies like Chevron are using powerful servers to distribute computing power and information to every corner of their businesses, and not incidentally, they are reducing their dependence on costly mainframes and minicomputers. But few companies have early-retire-

The profits and pitfalls of a client/server environment are apparent when you examine how some typical businesses deployed Pentium and RISC servers.

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*By Nick Stam and
Tami D. Peterson*

ment plans for the mainframe. Instead they are choosing creative integration plans that emphasize each computer's strengths. All of these plans involve PCs as workstations, and most center on the current class of relatively inexpensive, extremely powerful application servers. Providing a mix of better flexibility and monetary savings compared with mainframe computers that dominated the network landscape just a few years ago, servers are increasingly the systems of choice.

The incentive to save is apparent. Given that an annual mainframe lease can cost several hundred thousand dollars—roughly the initial investment for a high-end server—over the course of 10 years, a company could bank millions of dollars and own its server hardware for the same price. By some estimates, servers lower the cost per transaction by between 3 and 20 times, depending on the actual setup. For instance, Jim Zell, Project Manager, Advanced Financial Information Systems for Chevron (San Ramon, California), says the company's Warren, Oklahoma, division has justified its initial downsizing effort by reducing costs by 25 percent in the first year of a five-year plan.

By contrast, six years ago Teachers Insurance Annuity Association—the world's largest pension fund, with \$120 billion in assets—started the move to a decentralized network and made up many of the rules along the way. "We didn't know we were doing client/server [computing] when we started," says Charles Dvorkin, vice president of Investment Systems at the

New York-based Teachers. "The term hadn't been coined yet."

Both software and hardware were selected by process of elimination: Sybase was the relational database of choice, but it only worked on Sun Microsystems' or Digital Equipment Corp.'s VAX platforms; nothing existed that would run on an IBM PC-based LAN. Teachers now has about 350 Sun workstations and 4 SPARCservers that coexist with the corporate PC-based Token-Ring network over a gateway.

MAY I SERVE YOU?

Earlier this year, we evaluated Pentium- and 486DX2/66-based application servers (for more information, see "Application Servers: At your Service," March 15, 1994). In this story, Ziff-Davis Labs tests the most powerful servers ever to grace the pages of *PC Magazine*. In this round of testing, half of the six evaluated servers cost below \$100,000 and rival the raw processing power of mainframes 10 to 20 times as expensive.

At the time of testing, the 90- and 100-MHz Pentium systems weren't shipping, so we concentrated on 60-MHz and 66-MHz Pentium-based systems: an AT&T 3455 from AT&T Global Information Solutions with four 60-MHz Pentiums and a Compaq ProLiant 2000 5/66 with two 66-MHz Pentium processors. We also expand our horizons to include midrange RISC-based servers: the Data General AViiON 8500, the DEC 3000 Model 800S AXP Deskside Server, Hewlett-Packard's HP 9000 Series 800 Model G70, and

IBM's RISC System/6000 POWERserver 590. The Sun SPARCserver 1000 that we started with was unable to complete testing.

As our latest tests confirm, the Pentium is a formidable competitor to RISC platforms in high-traffic transactional and decision-support client/server environments. Overall, the Compaq ProLiant outperformed all tested units except the HP 9000's PA-7100-based server and did so for about half the cost.

FILE AND APPLICATION SERVERS

Broadly speaking, there are two types of servers. *File servers* provide network users with shared access to stored data files and to networked printers. By contrast, *application servers* operate under a client/server computing model, with the applications divided between the server and workstations. In this case, workstations issue requests to the server, and the server performs calculations or database operations and delivers results to the workstations, where analytical tools are used to process and display the resulting data. Not surprisingly, Microsoft Windows is the environment of choice on the PC side, regardless of the server OS.

Intel architecture-based servers are still widely considered best-suited for file serving and, increasingly, simple applications sharing. Relational databases run best under a preemptive multitasking operating system such as Unix. When structured query language (SQL) databases, which first appeared on mainframes and minicomputers, were initial-

Suitability to Task: RISC Servers

Sporting from one to six processors, the systems represented show the breadth and depth of today's midrange application server market.

Our **expandability** rating is based on a server's potential for future growth. The primary considerations for this rating include the maximum number of installable processors, maximum RAM and hard disk capacity, and the number of internal and external drive options. Other considerations include the wattage of the system's power supply, the number of connectors, and the system's total number of available slots and drive bays.

The **transaction processing** score is based on each system's performance on our Ritesize IV Mixed Query test under actual LAN conditions. This exercise consists of four different queries: a processor query, a read-intensive query, a simulation of database

update, and a write to a separate data table. We attached each of the reviewed systems to a network of up to 60 PC workstations in a true client/server environment.

The **decision support** score reflects a system's performance on two separate client/server tests. The first test is strictly a processor query, which selects a small database and performs a series of calculations on the data. The

second test is strictly a read-intensive query within a 1.4GB database. The combination offers a good indication of a system's abilities to perform decision-support duties, which do not include updating or writing to the database.

SUITABILITY TO TASK	
Expandability	EXCELLENT
Transaction processing	GOOD
Decision support	FAIR
Ease of administration	POOR

Ease of administration ratings reflect how easy it is to set up and configure each of the server systems reviewed. The primary considerations for each system are administrative tools, the availability of remote monitoring, and the ease of hard disk setup—and disk array setup, where applicable. We also looked at separate utilities that make monitoring and optimizing the server easier.



ly rewritten for servers, Unix was the predominant multitasking environment. RISC-based servers and Unix by default became the hardware/software combination of choice.

Times have changed. Pentium has arrived and is a contender in the relational-database market, with shipping SQL databases for Intel platforms running not just on Unix but on OS/2 and Windows NT as well.

What hardware are companies choosing? According to InfoCorp, IBM maintains its lead in total worldwide server sales, with 36 percent of the market, most of which are PS/2 systems. Hewlett-Packard is second with 15 percent. Companies selling primarily Intel-based servers, such as Compaq, have a combined share of about 10 percent, but most perform print- and file-service duties. The remaining 39 percent of the market is split among several big and small players in this business.

That profile is bound to change as Pentium becomes an accepted application-serving platform, but there is reluctance to accept as a server what is thought of as a desktop computing architecture. The attitude of Jim Ryan, vice president at Alexander Reinsurance, a subsidiary of Alexander and Alexander in New York, is typical of this: "I wouldn't use the [Compaq] ProLiant for mission-critical client/server applications." Though his company has practically standardized on Compaq desktops and notebooks and has several Compaq NetWare file servers linked by T1 lines between five U.S. offices and London, Ryan isn't confident ProLiant systems can manage his database as reliably as the company's HP 9000 can.

Our test results show that Ryan's instincts may be right—at least for now. The two-processor HP 9000 Series 800 Model G70 we review led all tested units on the Ritesize IV Mixed Query test. Alexander's similar single-processor HP 9000 Series 800 offers the firm's networked users quick international access to key financial data.

DOWNSIZE, RIGHT SIZE, OR CAPSIZE

Realistically, many existing mainframe business applications cannot easily be ported to a distributed model. For exam-

When examining application servers that a large business would use as the core of an information network, there is more to consider than just hardware. You have to look very closely at design, throughput, and especially at how easy it is to configure and operate these

tractor-trailers of the computer world. While each system had a niche where it excelled, only Hewlett-Packard Co.'s HP 9000 Series 800 Model G70 server combined outstanding performance with ease of use and peerless support for a large LAN. The Compaq ProLiant 2000 5/66 led the group in overall value and is an appropriate choice for a smaller network.

At the heart of each member of HP's G server family is a pair of 96-MHz HP PA-7100 RISC processors. While chips in the PA line do not carry any internal cache, this system more than makes up for that by adding 2MB of external cache for each processor. And the chip's L1 modular design also allows easy updates and revisions that will increase performance in the coming years.

In terms of performance, the HP server stood alone. It was first on the Processor Query test, as well as on the critical Mixed Query test—leading its

ple, mainframe applications, such as keeping track of accounts receivable, shipping and receiving, point-of-sale transactions, credit authorizations, and customer billing fit the model. These applications typically comprise millions of lines of customized COBOL code that would take a lot of time to rewrite, and would require the reworking of the network information flow model.

Many companies are choosing to graft new client/server functions onto their existing networks, leaving the mainframes intact but with diminished emphasis. Sharing mainframe data with distributed systems—downloading production data for querying purposes either in real time or at scheduled intervals—is a step toward cost reduction

nearest competitors by 30 percent at peak throughput. The HP's only performance glitch was a midrange showing on the Read-Intensive query test.

The Compaq ProLiant 2000 5/66 impressed us with its combination of raw performance, ease of use, and ability to expand. For all but the largest networks, the Compaq ProLiant should suffice as an application server and at the same time provide more for the money. At about half the price of the HP system, the Compaq ProLiant shows that good performance can be achieved at a low price.

Finally, you don't buy a server just because of blazing benchmark test scores. You buy it because it meets the specific requirements of your office, because you trust the company, and because it gets the job done. In terms of support, Compaq and HP provide the knowledgeable people and tools to fulfill the promise of client/server computing.

when mainframes can't be eliminated. Where does a mainframe make sense today? The best example is in an airline reservation system, which performs thousands of transactions per second and generally uses software that is written in custom assembler code and runs on specially optimized operating systems.

INTEGRATION IS KEY

In Chevron's case, the integration of HP 9000 servers with the company's mainframes was driven as much by software as it was by the realization of long-term hardware savings. On its HP servers Chevron runs SAP R/3 financial software, a downsized version of the SAP R/2 software that runs on Chevron's mainframes. Although the SAP R/3 software is also

COVER STORY

RISC Servers

currently compatible with servers made by many different manufacturers, Zell says HP was selected for its performance and customer service.

The servers we review represent one of the enabling components of the shift away from centralized computing. Centralized computing still conjures up visions of the big mainframe locked away in a glass room performing mission-critical processing, while being tended by technicians in white lab coats. At the other extreme, robust PCs on LANs have improved the situation by creating more productive computing environments for end users and workgroups. Most downsizing efforts meld the two extremes.

THE MORE THINGS CHANGE . . .

The goal is lights-out computing that requires little human intervention; Turn it on and let it run. Existing business operations cannot come to a halt while the bugs are worked out of the new systems. Take, for example, the situation at Prince Rupert Grain, headquartered in Vancouver, British Columbia. Prince Rupert, a consortium of Canadian grain growers organized in 1983 that handles 25 percent of Canada's export of wheat and barley, operates 24 hours a day. The company started with Digital VAXs and still operates six 3100 models. But it has since moved the automated control of its \$300 million plant, in several phases, to five Digital 3000 Alpha servers. "Those Alphas are our mainframes," says Alex Yovanovich, systems manager. With remote boot capabilities and ISDN lines to the homes of plant supervisors who take rotating responsibility, the Alphas are monitored 24 hours a day.

At the highest level of abstraction, distributed computing means moving computing power and data to where it's needed: the desktop. Multiple servers are often deployed in a peer-to-peer networked arrangement across multiple end-user sites to form the pipelines for the delivery of data to the individual users.

This model works well when a company sets up identical hardware at multiple sites that have similar requirements. For instance, at H-E-B Grocery Co., the largest privately held grocery chain in the U.S., application servers manage in-store product inventory and monetary transac-

tions. At each of over 200 sites there's a satellite dish and an NCR 3445 file server talking real-time to a two-Pentium NCR 3525 application server at company headquarters in Austin, Texas. The home system handles debit-or-credit bank transactions for customers at check-out. Another two-Pentium system, an NCR 3455, manages on-line prescription and client-profile data for H-E-B's in-store pharmacy departments. Both Informix and Oracle SQL databases underlie these operations, which also interface via TCP/IP and SNA gateways with the company's IBM ES/9000 mainframe.

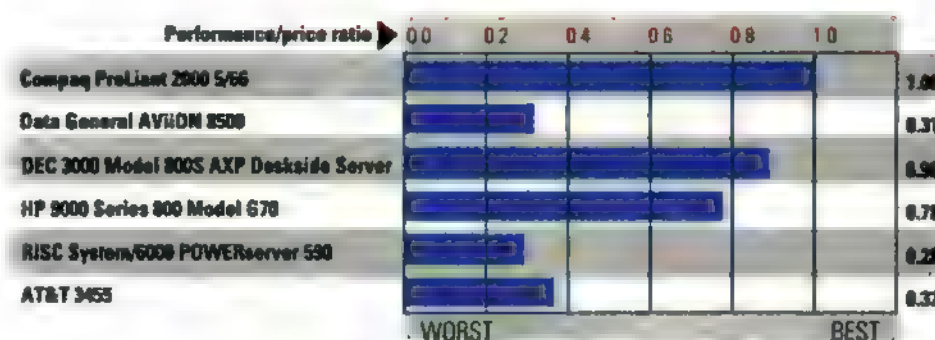
"It'll be a long time before the IBM is gone," says Bob Kilough, manager of store systems. He's working to offload the mainframe, which holds the company's legacy systems, but concedes, "We'll be running IBM mission-critical applications for some time, at least for the next 10 to 20 years—maybe forever."

Depending on company size, target applications, resources on hand, and the all-important budget, making the shift from centralized to distributed computing for a large corporation is seldom less than a five-year proposition. The common hidden danger is underestimating the time, cost, or both. Similar to when you're remodeling your house, if you're going to tear down, build up, or expand your computing environment, get ready to live with inconvenience and cost. "We walked into the same cobwebs and pitfalls as other companies," says the MIS director at one of the world's largest management consulting firms. "We were underspecced to begin with. What was scheduled for three months took one year." Likewise, what was budgeted at about \$300,000 ended up costing over \$1 million.

After completing a project, many companies realize they haven't gone far enough. What constituted a flourishing first phase may or may not work for the next phase. Software and hardware vendors' strategies can change, continually forcing a reappraisal of migration plans.

"We're maxed out," says Ed Bromwell, manager of distributed applications for Random House at one of its distribution plants in Maryland. Except for its New York headquarters, Random House is an IBM shop throughout, with a 3090 mainframe, several AS400s, a couple of RS/6000s, and over a hundred PCs running LAN Manager on a Token-Ring network. Microsoft and Sybase SQL databases for OS/2 version 2.1 run an order-entry system that handles over 3,000 orders each day. The next step:

Performance/Price Ratio: RISC Servers



To determine each system's performance/price ratio, we normalized its performance on our Mixed Query performance test across the full range of client loads and divided by its list price.

expanding to the new distribution center in New Jersey.

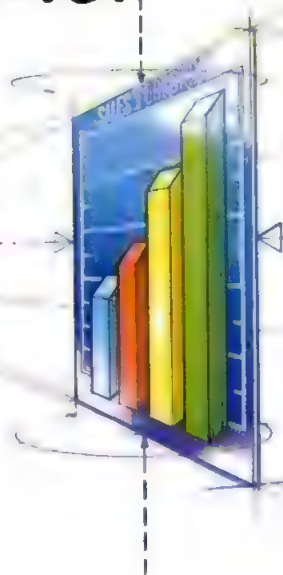
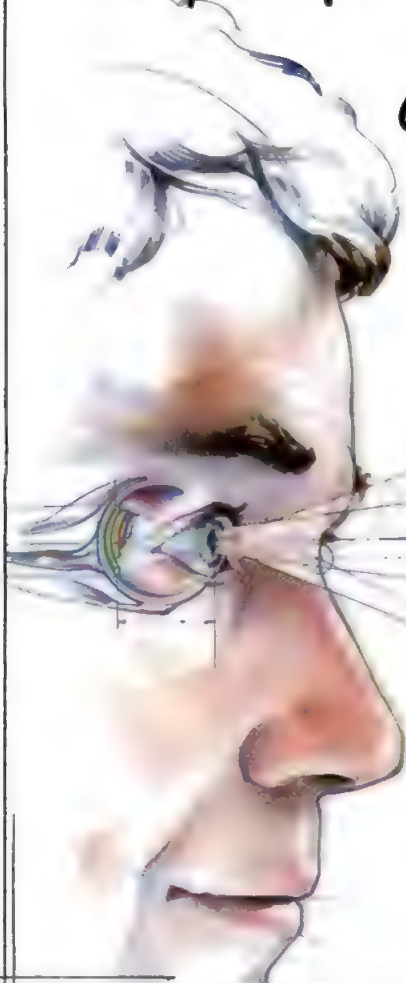
There's a snag, however: software cost. Random House owns an unlimited-use OS/2 license for Sybase SQL Server that cost \$7,900 in 1991. Should the company need to change to a different operating system, software costs could run \$92,000. "I've hit a roadblock," says Bromwell.

REVIEW CRITERIA

To evaluate the state-of-the-art of application servers, we asked vendors of RISC- and Pentium-based servers to provide shipping systems that support the Sybase SQL Server, Version 10.0, relational database. We asked them to deliver their best-performing systems for our 60-client test environment that works with a 1.4GB database.

We received a multiprocessing RISC-based system from Data General, with six Motorola 88110 CPUs, and Hewlett-Packard with two PA-RISC CPUs, as well as single-processor RISC systems from Digital, with one Alpha CPU, and IBM, with one POWER2 CPU module. In addition, we received two multiprocessing Pentium systems, a two-Pentium Compaq

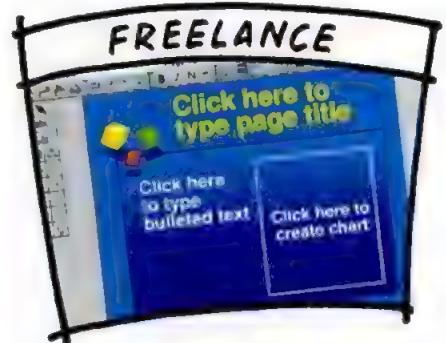
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What The Numbers Mean

MIXED QUERY

The clear winner was the HP 9000 Series 800 Model G70, which achieved a peak throughput of 216.5 transactions per second (tps) and showed itself to be a good all-around server. Its two 96-MHz PA-7100 chips and architecture—including a high-speed HP Precision I/O Bus and proprietary drives—were contributors to this result.

Second place was held by an unusual pair. The Data General AViiON 8500 harnessed six Motorola 88110 processors and the CLARiiON disk subsystem to achieve a peak throughput of 155.9 tps. A surprise outsider, the Compaq ProLiant 2000 5/66 with two 66-MHz Pentium processors and the SmartDrive disk subsystem, also performed well, proving that to be a player in the client/server RISC market, you don't have to rely on a powerful chip alone. In fact, to excel on our Mixed Query test, the entire system—the CPU, disk subsystem, and interface cards—must perform as efficiently as possible. Compaq's success in fine-tuning its server is what differentiated the Compaq ProLiant from the other Pentium machine here, the AT&T 3455, and set it above many other contenders on some of our tests.

In third and fourth place were the IBM RISC System/6000 POWERserver 590 and the DEC 3000 Model 800S AXP Deskside Server. The POWERserver 590 led by a tiny margin, with a maximum throughput of 112.2 tps. The DEC 3000 Model 800S peaked at 109.7 tps.

The laggard on our Mixed Query test was the AT&T 3455 with four Pentiums. We were prepared for both Pentium machines to bring up the rear in this group, but the Compaq ProLiant showed that fine-tuned components can effectively compensate for the CPU disadvantage.

PROCESSOR QUERY

The HP 9000 Series 800 Model G70 topped the charts with a maximum throughput of 145.3 tps. Its pair of 96-MHz PA-7100 processors can access memory at a maximum rate of 384MB a second. Each CPU (with no on-chip cache) is supported by 2MB of external cache. The IBM RISC System/6000 POWERserver 590's maximum throughput of 121.7 tps was remarkable for a single-processor system; it uses a CPU module that contains 256K of cache.

The other servers clustered together in a group led by the six-CPU Data General AViiON 8500, which had a maximum throughput of 95.6 tps. Its Motorola 88110 processors are each supported by 1MB of external cache. It was followed closely by the Compaq ProLiant 2000 5/66, which has only 256K of cache for each of its two processors but is aided by its TriFlex architecture, which allows the processors to be fed by the memory through a 128-bit channel. Taking into account the 2MB of external cache, the DEC 3000 Model 800S AXP Deskside Server's maximum throughput of 72.0 tps was disappointing. The four-processor AT&T 3455 finished last, with a maximum throughput of 63.1 tps. Its lackluster performance reflects the inadequate support built around its Pentium processors (each 66-MHz Pentium has 256K of external cache), rather than the Pentium's inherent shortcomings.

The RISC chips in these machines use two strategies to achieve high

performance: They have high clock speeds to dispatch instructions through pipelines quickly, and they execute as many instructions as possible.

READ-INTENSIVE QUERY

To examine the effect of disk I/O, we ran our grueling Read-Intensive Query test on all the servers. To maximize throughput and assure consistency, Sybase maintains a high degree of control over each machine's I/O subsystem. To avoid disk and I/O problems, Sybase strongly recommends setting up the database on raw disk partitions. This procedure gave us an opportunity to assess the system administration utilities on these servers while setting up these structures.

The Compaq ProLiant 2000 5/66 disk subsystem excelled on this test, thanks in part to its two Smart SCSI Array controllers and the Enhanced ProLiant Storage System supported by 4MB of memory for caching. The eight 1GB drives were striped in a RAID 0 configuration. The Compaq ProLiant peaked at an astounding 81.0 tps, more than 50 percent better than the peak performance of the next best system. More important, its performance did not fall off until about 30 workstations were asking for data, a higher client load than any other server reached before falling off.

Two other servers performed well, probably by virtue of their Logical Volume Managers, which enabled a limited degree of hardware striping of disks. The IBM RISC System/6000 POWERserver 590 drew out a maximum throughput of 53.7 tps before dropping rapidly in performance. The HP 9000 Series 800 Model G70 peaked at 45.8 tps and then also dropped off.

The Data General AViiON 8500, with its CLARiiON Disk Array, led the rest of the pack with a peak throughput of 27.7 tps. As expected, network access was not an issue on this test. Network traffic was low, and no contention was detected on the hubs.

MULTIPROCESSING SCALING

The Compaq ProLiant 2000 5/66 relying on a pair of Sybase engines outran the single-engine configuration by nearly 50 percent at peak load. In high-load situations, however, the performance of the dual-engine configuration fell off more quickly than the performance of the single-engine configuration.

Going from a single-engine configuration to a triple-engine configuration increased the performance of the Data General AViiON 8500 by 50 percent or more at high client loads. Going from three engines to five resulted in only a minor performance gain.

Clearly a winner in two-processor mode, the HP 9000 Series 800 Model G70's transactional processing performance jumped by about 50 percent at higher client loads when going from a single Sybase engine to two.

We tested the AT&T 3455, which can accept up to six Pentiums, with single-, double-, and triple-engine configurations. Going from one to three database engines increased performance by 25 percent or more.—*Analysis written by Mark Jónikas*

How We Tested

The Ritesize IV test suite, which was developed and run at ZD Labs, uses an actual network of 60 client stations—a mix of 386- and 486-based machines. FTP Software's PC/TCP Plus, Version 2.3, was used to connect the workstations to the servers via TCP/IP (Transmission Control Protocol/Internet Protocol) over an Ethernet network. The network was divided into four segments, each of which communicated with a separate network card on the server.

Each server ran its own version of Unix and Sybase's DBMS-System 10. Based in Emeryville, California, Sybase is a leading database vendor known for its broad cross-platform support. System 10 offers a host of features important

to large client/server systems. The database consists of two tables: a Product table with 1.2 million rows and a Part table with 4.8 million rows. Each Product row has four corresponding Part rows.

The servers were set up so that each workstation accessed its own subset of the database and there was no contention for access to the rows of these tables. Both tables were indexed. Four queries were used on our tests:

- The processor query selects a small cacheable subset of the database and performs calculations on this data.
- The read-intensive query performs a join of two tables, which accesses 10MB of data per client station. Since the tests use up to 60 clients, we were sure to exceed the 256MB of RAM cache available on our servers early in our test run.
- An update-in-place is performed on the original Product table. This is a write mode that guarantees that only one row will be affected within the table and that no reorganization of the database will occur.
- The write-intensive query is performed on a separate table, set up with a clustered index based on each station, ensuring that stations will not be

held up trying to access a page being written to by another station.

Three tests are run on each server. The **Mixed Query** test imitates a mixed workload by running all four queries in a ratio of 5:1:5:5. This simultaneously stresses all the components that would typically be used by a DBMS server.

The **Processor Query** test runs the processor query only, and the **Read-Intensive Query** test runs the read-intensive query only. On the machines with more than one processor, we also run **Multiprocessing Scaling** performance tests to show the scaling effect of running a mixed query with different numbers of processors.

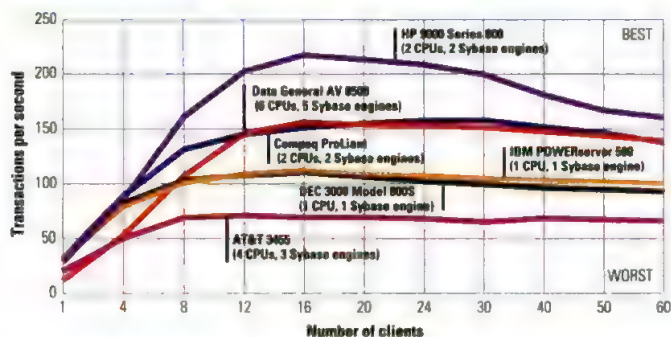
The test procedure starts with one station issuing the queries to the server for 10 minutes. The first 3 minutes 45 seconds are not timed and are intended to allow the cache to stabilize itself.

During the next 5 minutes, the number of transactions executed is counted. This is followed by a nontimed 1 minute 15 seconds. The process is then repeated with 4 stations issuing queries, then 8 stations, then 12—up to 60; there is a 30-second quiet period between iterations.

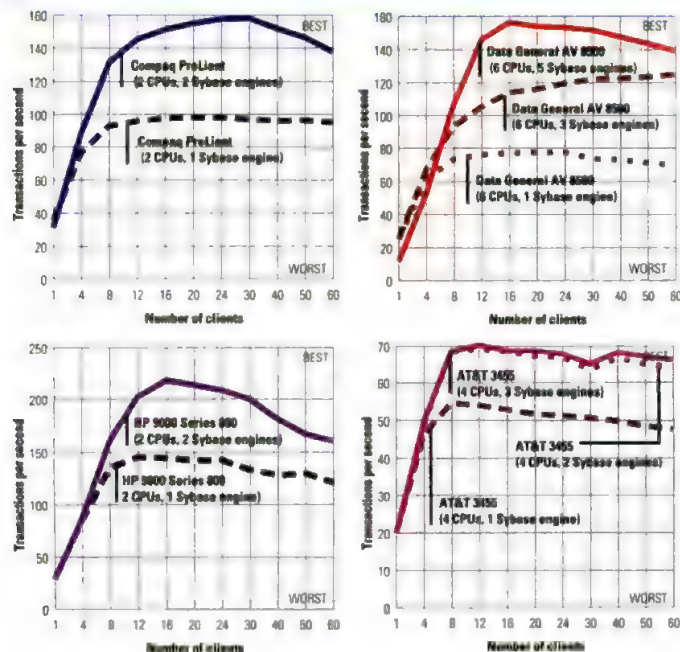
In an attempt to maintain a level playing field, we applied the same basic tuning to all machines. In addition, Sybase has parameters that are well documented and configurable by the database administrator; using the stored sp_configure procedure, we allocated 200MB of the available 256MB of RAM to Sybase for each server.

Procedure cache was lowered from 20 percent (the default) to 5 percent; since only a very small number of stored procedures were used on these tests, 95 percent of the 200MB could be allocated to data cache. We used vendor-specific parameters only where they were recommended as standard in the Sybase documentation.

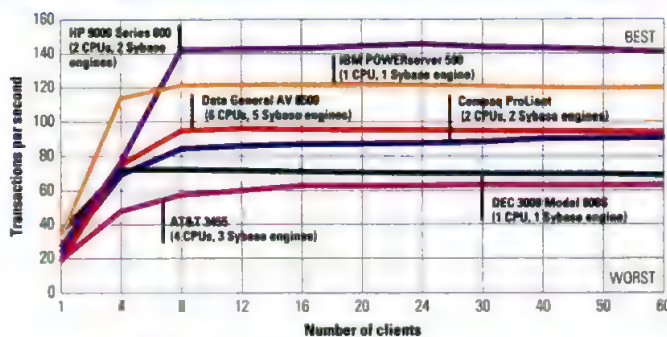
MIXED QUERY



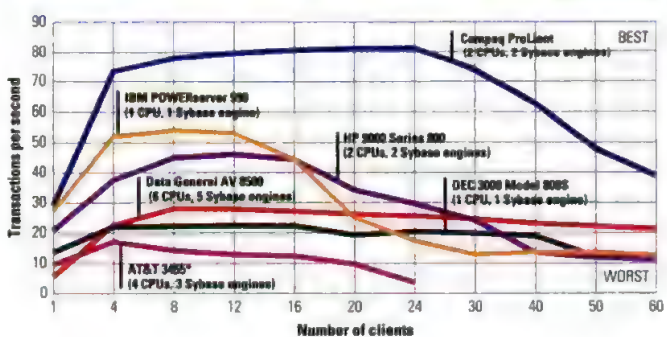
MULTIPROCESSOR SCALING



PROCESSOR QUERY



READ-INTENSIVE QUERY



* The AT&T 3455 could not perform this test with more than 24 clients

ProLiant and a four-Pentium AT&T 3455 system. All systems had 256MB of memory and between 5.2GB and 9GB of disk space. Unfortunately, Sybase 10.0 is new and all the kinks hadn't yet been worked out. For instance, we began testing a Sun SPARCserver 1000 with four SPARC CPUs, only to have the company withdraw the system because it could not complete all our tests.

All of the tested servers use some flavor of Unix, which offers a range of useful features: preemptive multitasking, virtual memory management, high-performance file systems, robust interprocess and remote communication facilities, as well as a variety of tuning parameters. Recent versions support multithreaded kernels and symmetric multiprocessing (SMP). Windows NT or OS/2 are not represented because they are not as yet supported by Sybase 10.0. The Unixes represented are: AT&T's MP-RAS Unix; Data General's DG/UX 5.4.3 (SVR4); IBM's AIX 3.2.5, which adds many SVR4 features; Digital's OSF/1 for AXP V1.3, which is based on the 64-bit Carnegie Mellon Mach Kernel technology with elements of SVR4 and BSD; Hewlett-Packard's HP/UX 9.04, which is based on SVR3 and BSD 4.3. Compaq uses the SMP version of SCO Unix 4.2 based on SVR3.

MULTIPROCESSOR MUSCLE

In the mainframe and minicomputer realm, multiprocessing is anything but new. In fact, IBM's largest multimillion-dollar mainframe, the ES/9000 Model 982 supports up to eight processors. The reviewed AT&T 3455 server supports up to six Pentium processors, and its big brother in the 357x line can support up to 32 Pentiums. Don't get the mistaken impression that the AT&T unit will outperform an ES/9000 Model 982 in all areas, because a large part of a mainframe's strength is unmatched I/O capability.

Symmetric multiprocessing systems allocate both user and system tasks equally among processors, with one CPU doubling as the task scheduler. A symmetric system usually has multiple CPUs and cache boards or modules that plug into a single fast interconnect bus and share common system memory. By contrast, asymmetric multiprocessing assigns specific tasks or classes of tasks to specific

processors, such as I/O and application processes.

Operating systems must take advantage of multiple processors, and applications should be split into different threads of execution to gain benefits. For multiprocessing servers with more than two CPUs, Sybase 10.0 works best on a configuration with one Sybase engine—or thread of execution—less than the num-

*Symmetric multiprocessing
systems allocate user and
system tasks equally among
several processors,
with one CPU doubling as
the task scheduler.*

ber of CPUs installed if Sybase is the system's only application. For two-processor servers, two Sybase engines work fine. But for a three-processor server, two Sybase engines is the configuration of choice. For example, we configured five Sybase engines on the six-processor Data General system. In our testing, there was a noticeable fall-off in performance when we ran the AT&T system with four Sybase engines as opposed to three.

Our testing took place in three phases. The Processor Query test focuses on the CPU-to-memory bandwidth in the server systems. The test stresses CPU and memory and mirrors a small database that fits entirely into the processor's cache, or a larger database with frequently accessed tables that are fully cached. Aside from the numbers of processors present in a system, the internal and external cache architectures, memory design, interconnection buses, and processor architecture contribute to overall processor and memory performance.

HP's two 96-MHz PA-RISC 7100 processors captured center stage, delivering an impressive peak 145 transactions per second (tps) on the Processor-Intensive Query test. Each PA-RISC CPU contains no internal cache, but makes up for this deficiency with a large amount of off-chip L1 cache: Our test unit contained 1MB of instruction cache and

1MB of data cache per CPU. The large L1 cache definitely can assist in CPU-intensive operations. IBM's system, which uses a single-processor complex that can execute up to six instructions per clock cycle under specific conditions, placed second with peak performance of 122 tps. Because the processor complex favors floating-point operations, and since few if any floating-point operations are used in database processing, the CPU never reaches its full potential. While its 288-bit path to memory can yield an astounding maximum 2.136 gigabyte-per-second (GBps) peak bandwidth, the system's throughput usually runs closer to the slightly more pedestrian 1 GBps.

The Data General system with six processors placed a distant third at 95 tps on the Processor Query test, possibly because of its older Motorola 88110 chip design. Digital's single 200-MHz Alpha chip-based server placed much lower on the Processor Query, a likely result of its memory path of 256 bits and throughput of 114 megabytes per second (MBps). The biggest disappointment was the quad-Pentium AT&T system, which could only muster up a peak of 63 tps. We can only suspect that there may be a bottleneck with shared memory access from multiple processors.

HIGH-OCTANE DISKS

Hard disk subsystems are without question critical to server performance. Regardless of whether you're using RAID (Redundant Array of Inexpensive Disks) systems or SLEDS (Single Large Expensive Disks), the more spindles (number of disk drives) the better. The number of disk adapters also affects performance, and many vendors provided two or more adapters and split their physical drives between the adapters to help alleviate bus bottlenecks.

All vendors were asked to tune their disk subsystems to handle our database most efficiently, which involved setting up multiple striped logical drives (two or more physical drives per logical drive) and optimizing the placement of database tables, indexes, and log files. Striping was accomplished at either the hardware or Sybase level, depending on the system (refer to the reviews and Summary of Features table for specifics). We learned

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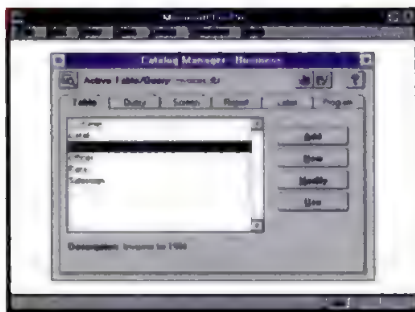
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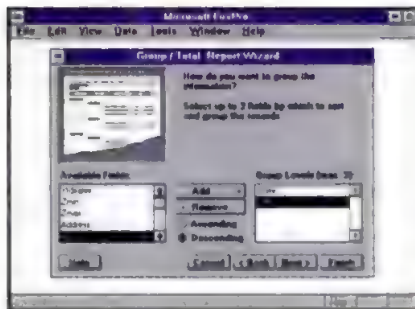
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that with multiple SCSI-II drives, a good rule of thumb was not to place more than four drives on a host adapter. Between multiple drives, controllers, caches, striping methods, raw partitions, data buffering done by Sybase, and understanding your database's disk-access characteristics, disk optimization is not for the faint of heart.

Our Read-Intensive Query test pushes disk access to the limit and simulates a decision-support model of database access, in which many workstations are requesting server resources. The Compaq ProLiant stood far above the pack by integrating hardware and software. The system's 4MB cache in its external storage system and two EISA-based Smart SCSI array controllers was a start, but performance was augmented by Compaq's special drivers and extensive tuning of both the SCO Unix's file accesses and Sybase. For small client loads in which most of the database accesses are cacheable, IBM's system performed well, reflecting the system's superior CPU-memory-complex throughput and software tuning. At between 20 and 25 clients, the Read Query performance becomes disk-bound, stressing the throughput of the disk hardware and the efficiency of the operating system and of Sybase.

Our Mixed Query testing simulates transaction-processing applications and is a good test of overall server performance. The PA-7100-based HP 9000 Series 800 is a real transaction-processing workhorse. Maintaining the highest tps results across all client loads shows HP's well-balanced high-performance architecture. Also, it was no surprise that Compaq was among the leading performers with its stellar disk performance. The single-processor IBM and Digital units were close to each other and delivered respectable results. AT&T's server was a major disappointment; it is difficult to determine if its hardware or software was at fault. Compaq proved that excellent overall performance can be achieved with Pentium processors and finely tuned software.

A new picture emerges when you combine information on performance and pricing. Our Performance/Price Index shows the winners and losers. The

winners in the value category are Compaq's ProLiant and the DEC 3000 Model 800S, each of which was priced under \$60,000, but neither of which could handle the traffic of a large network. That's where the HP 9000 Series 800 server fits in. It is the highest performer of the group, but is priced at just over \$100,000. The IBM, Data General, and AT&T systems lagged.

KEEP ON RUNNING

There is much more to these servers than CPUs, memory, and hard disks. These systems all provided varying levels of fault tolerance. Some vendors call it high availability, others call it RAS (reliability, availability, serviceability), and we've seen some use the term fault resilient. Call it what you will, the goal is to keep your server up and running without corrupting your data or disrupting your mission-critical operations. RAID disk subsystems with parity data encoded on one or multiple drives, disk mirroring, and hot-swapability are now old hat. Expensive ECC (error-correction code) memory, which was present in all tested servers, insures that single-bit or multi-bit errors are either corrected or flagged.

Many other features, including multiple fans, multiple power supplies, built-in UPSs, temperature sensors, alarms, and dial in/out service ports are common in many systems. Compaq stands out by including a Drive Parameter Tracking (DPT) facility in its Insight Manager utility that predicts impending disk faults. For example, a disk drive might be slowly experiencing more and more recoverable soft errors. DPT will detect and report the situation so the disk can be changed before it dies.

Server configuration and administration facilities are crucial in the Unix environment. Arcane commands and complex procedures litter the Unix landscape, so any tools that help assuage otherwise frustrating setup and management functions are a real benefit. IBM's System Management Interface Tool (SMIT) and Compaq's SmartStart and Insight Manager utilities are a big help.

Also, don't downplay the benefits of a good relationship with the manufacturer of your server. Look for comprehensive performance monitoring, security, and

diagnostic features when comparing servers. You must compare system warranties, exchange policies, and general vendor support plans. Beyond that, make sure all the pieces of your client/server jigsaw puzzle fit together.

Compaq Computer Corp.

Compaq ProLiant 2000 5/66

The surprise performer in this roundup was the two-Pentium \$55,052 Compaq ProLiant 2000 5/66. Not only was it an excellent performer, placing second only to the Hewlett-Packard server on our Mixed Query test, but thanks to its SmartStart intelligent setup utility, it was very easy to configure. The ProLiant series includes Compaq's top-of-the-line systems, and it includes one-, two-, and four-processor configurations.

Each of the 66-MHz Pentium processors in the tested Compaq ProLiant is supported by 256K of external cache, and it is connected with the CPU via a 64-bit path. Compaq's proprietary TriFlex architecture features a custom-designed ASIC and a 128-bit path between the processor and the fast-paged interleaved memory subsystem.

The system comes standard with 32MB of advanced ECC DRAM, expandable to a maximum of 512MB; our test system came with 256MB of RAM. The standard drives include a 1.44MB floppy disk drive and a CD-ROM drive. I/O is handled via a standard EISA bus, but the disk controllers used by Compaq are proprietary.

The Compaq Smart SCSI Array controller employs all the advantages of Fast SCSI-2 to ensure optimal I/O handling. Using up to five controllers, with each controller supporting a maximum of fourteen 2GB drives, the ProLiant has a total capacity of 147GB of disk storage space if sufficient slots are available.

Our test system had two internal drives set up on one controller and six external drives set up on another. Compaq's Enhanced ProLiant external Storage System is a cabinet housing the external drive system. It is enhanced by a pair of mirrored 2MB disk-cache modules. These are battery-backed to protect against power failure. Compaq's Full Spectrum Fault Management compares favorably with any of the other vendors' fault-manage-



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ment schemes, with Compaq's Insight Manager monitoring over 800 items concerning the server's operating status.

The flavor of Unix used on the Compaq was The Santa Cruz Operation's SCO Version 4.2. SMP support was provided by the MPX extension, Version 3.0. SCO is based on SVR3 and provides the system administration utility for system configuration. In this case, we were surprised at how easy it was to set up and configure SCO. This was largely due to the SmartStart CD-ROM system, which asks some questions about the computer's physical configuration and then uses optimal system parameters already determined by Compaq for the configuration. In particular the system makes intelligent choices for memory allocation, taking into account both SCO's needs and those declared within the Sybase configuration used for our tests.

The Compaq ProLiant's high performance startled us. On the Mixed Query test, it had maximum throughput of 157 tps at 24 workstations. This put it second only to the powerful HP 9000 Series 800 Model G70 configured with two Sybase engines and two CPUs (see "How We Tested") and tied it with the Data General AViiON 8500, which runs five

► SUMMARY OF FEATURES

CONTINUES

RISC Servers

List price (tested configuration) We report the prices for the RISC servers configured the way we tested them.

Power supply (and number of connectors) We list the wattage of each power supply and the number of connectors for each. The number of connectors directly affects how many devices—such as hard disks, floppy disk drives, and CD-ROM drives—the server can power. In the case of the Data General AV 8500, all power connections are made through the system's motherboard.

A secondary, or redundant, power supply automatically takes over if the primary supply fails. An **uninterruptible power supply (UPS)** will keep your machine going at least long enough for you to power down without crashing.

Processor For each unit, we report the number of processors and their speed. Of the six servers we tested, four use IBM RISC chips: The Data General AV 8500, DEC 3000 Model 800S AXP Deskside Server, HP 9000 Series 800 Model G70, and IBM RISC System/6000 POWERserver 590. The Compaq ProLiant 2000 5/66 carries two 66-MHz Pentiums; the AT&T 3455 uses four 60-MHz Pentiums.

Installable system RAM indicates the range of system memory that each server supports. Some of the tested application servers use memory cards in addition to motherboard-mounted memory to reach the maximum level of supported RAM.

Installable external RAM cache (per processor) Unlike with RAM, where all processors share the same memory space, each processor is allocated its own external (or Level 2) RAM cache, the amount of which can directly affect processor performance.

Bus architecture (primary, secondary) refers to the system's bus that connects the I/O slots to the CPU.

Bus-mastering slots offer another way to increase a computer system's processing speed by accepting expansion cards containing additional circuitry. This bus-mastering circuitry lets the card control its own read/write operations, freeing the CPU to handle other tasks. With **non-bus-master-**

ing slots, the main processor controls the expansion cards' read/write operations.

Other slots accounts for the remaining expansion slots, which include local-bus, VL-Bus, and PCI slots, as well as proprietary special-purpose designs.

Maximum number of installable hard disks indicates the number of hard disks the system is capable of supporting. We also indicate the **total disk capacity**.

We list the **hard disk manufacturer and type** for each application server we tested.

RAID levels supported Depending on the configuration, or level, of the RAID (Redundant Array of Inexpensive Disks), different combinations of data security and speed features can be built into the hard disk subsystem. Some of these features include disk mirroring, parity checking, and data striping. Note that a higher RAID level number does not necessarily indicate a better-performing or more efficient RAID design.

Other compatible operating systems Most of the servers we tested include only one compatible operating system, enabling vendors to optimize their systems to a particular OS. Others, such as the Compaq ProLiant, can handle a variety of operating environments.

Fault tolerance means that a system or subsystem can continue to function even though a part of it has failed. We list whether or not the **processors, drives, controllers, and power supply** are fault-tolerant.

A server featuring **system-management notification** will alert the network administrator when special conditions or problems occur. Some servers offer remote notification, which notifies the administrator of these conditions or problems via a modem or pager.

A **temperature sensor** monitors the temperature inside a server's chassis. If the temperature exceeds a particular point, a fan is activated. Some servers will also notify the network administrator that the server is overheating.

► FACT FILE

Compaq ProLiant 2000 5/66

EDITOR'S
CHOICE

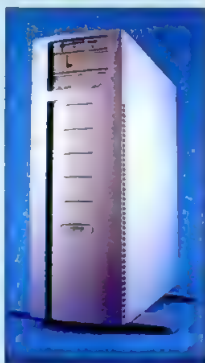
List price (tested configuration) \$55,052

Configuration: Two Pen-

tium/66 CPUs, 256MB RAM, 256K write-back cache per CPU, eight Micropolis Model 2112 1GB Fast SCSI-2 hard disks, Compaq Smart SCSI Array controller with 4MB cache, 1 44MB floppy disk drive, Compaq CDU-561-31 CD-ROM drive, four Compaq NetFlex-2 ENET-TR network interface cards. **In short:** A serious contender in this market, the Compaq ProLiant 2000 5/66 demonstrated great performance, was easily configured, and has one of the lowest prices in this roundup.

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14L8 (IBM Credit Lease: \$45/mo.***) \$1,259*

433DX/Si

486DX/33MHz[†], 120MB HD, 4MB RAM
14L8 (IBM Credit Lease: \$59/mo.) \$1,639*

433DX/Si

486DX/33MHz[†], 212MB HD, 4MB RAM
14L8 (IBM Credit Lease: \$63/mo.) \$1,749*

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14L8 (IBM Credit Lease: \$57/mo.***) \$1,589*

433DX/D

486DX/33MHz[†], 212MB HD, 4MB RAM
14L8 (IBM Credit Lease: \$69/mo.) \$1,939*

450DX2/D

i486DX2/50MHz, 340MB HD, 4MB RAM
14L8 (IBM Credit Lease: \$81/mo.) \$2,259*

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14L8 (IBM Credit Lease: \$107/mo.) \$2,989*

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SUMMARY OF FEATURES

RISC Servers

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Products listed in review order

■ YES □ = NO

	Compaq ProLiant 2000 5/66	Data General AV 8500	DEC 3000 Model 800S AXP DeskSide Server	HP 9000 Series 800 Model G70	RISC System/6000 POWERserver 590	AT&T 3455
First price (tested configuration)	\$55,052	\$167,500	\$42,456	\$102,000	\$142,422	\$67,805
Power supply (and number of connectors)	445W (8)	1,020W (none)	686W (6)	Two 800W (2)	750 (20)	720W (11)
Uninterruptible power supply	□	□	□	□	□	■
Warranty	3 years	1 year	1 year	1 year	1 year	1 year
On-site service charge	Included (3 years)	Included (1 year)	\$2,473 (1 year)	Included (1 year)	Included (1 year)	Cost varies
Processor, Memory, Bus						
Processor	2 Intel Pentium (66 MHz)	6 Motorola 88110 (50 MHz)	1 DEC Alpha AXP 21064 (200 MHz)	2 HP PA-7100 (96 MHz)	1 IBM POWER2 (66 MHz)	4 Intel Pentium (60 MHz)
Installable system RAM	32MB-512MB	64MB-2GB	32MB-1GB	32MB-768MB	64MB-2GB	16MB-1GB
Installable external RAM cache (per processor)	256K	1MB	2MB	2MB	N/A	256K
CPU bus	64-bit Compaq TriFlex	64-bit proprietary	128-bit proprietary	32-bit HP-PB	32-bit MCA	64-bit proprietary
Bus architecture (primary, secondary)	EISA, proprietary	VMEbus, proprietary	TURBOchannel	HP-PB	MCA	Proprietary, MCA-E
Number of bus mastering/non-bus-mastering slots	8, 0	6, 0	6, 0	4, 0	8, 0	7, 0
Other slots	1 memory, 1 modem, 2 processor	10 proprietary, 4 SCSI-2, 2 LAN	14 SCSI-2	None	None	None

Hard Disks

Maximum number of installable hard disks (and total disk capacity)	70 (147GB)	405 (870GB)	95 (200GB)	63 (166GB)	230 (460GB)	49 (504GB)
Hard disk manufacturer and type	Compaq SCSI-2	Data General SCSI 2, IBM SCSI-2	DEC SCSI-2	HP SCSI	IBM SCSI-2	DEC SCSI-2
RAID levels supported	0, 1, 4, 5, 10	0, 1, 3, 5	0, 1, 0+1	3, 5, independent	None	0, 1, 3, 5

Software

Type of Unix supported	SCO Unix 4.2	DG/UX 5.4.3	DEC OSF/1 AXP V1.3	HP-UX 9.04	IBM AIX 3.2.5	NCR Unix SVR4 MP RAS
Other compatible operating systems	Microsoft LAN Manager, Microsoft Windows NT, NetWare, OS/2, SCO Open Desktop, SCO Open Server, VINES	None	Open VMS	None	None	Microsoft Windows NT

Fault Tolerance and Management

Processors	■	□	□	□	□	□
Drives	■	■	□	□	□	□
Controllers	■	■	□	□	□	□
Power supply	□	□	□	□	□	□
System management notification	■	■	■	■	■	■
Temperature sensor	■	■	□	■	■	■

N/A—Not applicable. The product does not have this feature.

SyBase engines and six CPUs. Our Multi-processing Scaling Performance tests showed a 62 percent improvement obtained by using two Pentiums instead of one. On the Processor Query test it didn't fare as well, being outgunned by the RISC-based HP, IBM, and Data General machines.

With a throughput of 90 tps in its two-engine configuration, the Compaq ProLiant outperformed the AT&T 3455 configured with three engines and four CPUs and the single-engine, single-CPU DEC 3000 Model 800S AXP DeskSide Server. Compaq's gain over the AT&T 3455 on

this test can probably be attributed to the TriFlex architecture and its speed in transferring data from memory to CPU.

On the Read-Intensive Query test, the Compaq ProLiant pounded all its competitors with a top throughput of 81 tps, which it was able to maintain surprisingly well. Disk throughput certainly contributed heavily to the ProLiant's strong showing.

Compaq is surely a company to be reckoned with in the server market. In terms of price and performance, it is hard to ignore the power of the Compaq ProLiant. The two-CPU system, however, lagged on processor-intensive tasks. Its easy config-

urability should make it a hit with system administrators. The only concern would be expansion, as the ProLiant is currently the top of the line of Compaq servers. But with a maximum disk capacity of 147GB, it still leaves Compaq a large market of clients to satisfy.—Mark Jonikas

Data General Corp.

Data General AViiON 8500

Data General Corp.'s AViiON family comprises servers that range from the AViiON 4500, which is based on a single

processor, up to the AViiON 9500, which can be configured with up to 16 processors and is suitable for networks of more than 1,000 users. The \$167,500 Data General AViiON 8500 earned a well-deserved second-place rank (it tied with the Compaq ProLiant 2000 5/66) on the Mixed Query test. It was helped to this position by its impressive CLARiiON disk array system.

The system we tested was configured with six 50-MHz Motorola 88110 processors, mounted in pairs on three processor boards. Each Motorola 88110 processor came with 1MB of external cache that was shared between data and instructions. The AV 8500 system uses an asynchronous system bus for communication between CPU, memory, and I/O channels, allowing memory-to-CPU transfers at speeds of up to 250 megabytes per second (MBps). The Motorola 88110 processors are descendants of the 88000 family of chips that was the RISC successor to Motorola's 68000 family of workstation processors. The series was not overly successful in gaining market share, and today Data General is one of the only big-name customers for this processor.

The AV 8500 comes in a deskside

tower case on caster wheels. The system has ten proprietary slots, five VME slots, and a 1,020-watt power supply. Nine of the ten proprietary slots were occupied—three by the CPU boards, the remaining six by two I/O controllers and a memory controller containing 256MB of RAM made up of eight 32MB daughter cards (each I/O controller and memory controller uses two slots). The daughter cards for the memory modules come in 32MB and 128MB sizes. Supporting a maximum

*Since Motorola has
invested heavily in the
PowerPC architecture,
the future of its 88000
family of processors is
questionable.*

of two memory controllers, this machine can be expanded up to 2GB of RAM.

Our test system came with two 1GB internal drives and a Data General CLARiiON Series 2000 Disk Array, which is also housed in a deskside tower on wheels, similar to the AV 8500's case.

The system also includes its own monitor. The CLARiiON houses 20 3.5-inch SCSI drives, redundant power supplies, and dual differential SCSI interfaces. Each SCSI interface can be connected to a different computer supporting a SCSI-2 channel. The CLARiiON Disk Array can handle up to 40GB of traditional storage or 32GB of RAID (Redundant Array of Inexpensive Disks) storage. RAID levels 0, 1, 3, and 5 are supported. Our CLARiiON Disk Array came with seven 520MB drives. Configuring this setup was not a trivial affair: We required the assistance of a Data General engineer to accomplish the task.

The AV 8500 runs on the DG/UX 5.4.3 Unix operating system, a fairly standard SVR4 implementation of Unix. The main system administration utility is SVR4's standard system administration.

The AV 8500 tied with the Compaq ProLiant (with two CPUs) for second place on the Mixed Query test, achieving a maximum throughput of 156 tps at a client load

of 16 workstations. The AV 8500 owes this performance to the combination of its six processors and the RAID 0 striped drives in the CLARiiON disk array.

The Data General computer earned third place with a maximum throughput of 96 tps on the Processor Query test, following behind the HP 9000 Series 800 Model G70 and IBM's RISC System/6000 POWERServer 590 with their more modern processors.

On the Read-Intensive Query test, the AV 8500 provided us with performance averaging 23 tps, which placed it roughly in the middle of this test group. Unlike many of its competitors, this machine's performance did not quickly tail off with higher workloads.

The Data General AViiON 8500 is a fine performer, and the company's helpful and knowledgeable support staff provided us with fine support during our testing. But you should consider one caveat. Since Motorola has now invested heavily in the PowerPC architecture, the future of the Motorola 88000 processor family is questionable. Data General already faced the upgrade problem once, and at that time it chose to stay with the compatible 88110 chip because of its scalability. —Mark Jonikas

Digital Equipment Corp.

DEC 3000 Model 800S AXP Deskside Server

Based on the new Alpha chip, the single-processor DEC 3000 Model 800S AXP Deskside Server lies low to midway along the range of servers offered by Digital Equipment Corp. This series starts with the DEC 2000 Desktop Server and goes up to the DEC 10000 Enterprise Server, which is powered by six Alpha CPUs.

This \$42,456 server is based on the DEC Alpha AXP 21064, which runs at speeds ranging from 100 MHz to 275 MHz and was designed from the start to run a 64-bit architecture. The high clock speed combines with a simple set of 32-bit instructions, implemented to produce extremely fast performance. External cache is accessed through a 128-bit cache bus, allowing the system to refill efficiently an entire on-chip cache line in only two accesses. The

► FACT FILE

Data General AViiON 8500

List price:

(tested configuration)

\$167,500

Configuration:

Six Motorola 88110/50 CPUs, 256MB RAM, 1MB cache per CPU, two Data General 79100D 1GB hard disks and seven IBM 520MB hard disks, Data General DG7444 disk controller, Data General QICtape drive, Data General single-speed CD-ROM drive. **In short:** Price and easy configurability were not this unit's strong suits. The Data General

AViiON 8500 did compensate by turning in steady performance on most of our benchmark tests.

Data General Corp.:
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SUITABILITY TO TASK

Expandability	EXCELLENT
Transaction processing	GOOD
Decision support	FAIR
Ease of administration	GOOD

DEC 3000 Model 800S augments the Alpha's 24K of on-chip cache with an additional 2MB of external cache. Memory is accessed via a 256-bit-wide data bus with a throughput of 114 megabytes per second (MBps). The chip on the DEC 3000 Model 800S we tested runs at 200 MHz and it has a claimed SPECint92 rating of 120.5 and SPECfp92 rating of 184. Digital is ultimately aiming for an Alpha design running at a 1-GHz clock rate.

In its standard configuration the DEC 3000 Model 800S comes with 64MB of RAM (our configuration had 256MB) and can be upgraded to 1GB. Memory access is via a proprietary 256-bit bus with 114-MBps throughput. Digital has its TURBO-channel I/O interconnect for I/O bus access, which has six slots and offers a throughput of up to 100 MBps. The cabinet can hold up to four drives. The possible total internal disk storage space is 8.4GB. In our configuration, the system held one 1.05GB drive and two 2.1GB drives. The Dual Fast SCSI-2 card allows an additional 14 external storage devices to be connected. The StorageWorks desk-side expansion unit in our configuration held five additional hard disks that were necessary for our tests. All hard disks in our configuration were Digital's. Maximum internal and external disk capacity for this system is 200GB. The Ethernet support included both AUI and 10BaseT connectors. The input media available on our system was a CD-ROM drive.

Our configuration ran on DEC OSF/1 for AXP V1.3 and included OSF/Motif 1.1 as the windowing interface. OSF/1 is based on the Mach kernel developed at Carnegie Mellon University. The allocation of partitions on-disk, which follow the SVR4 model, was probably the most difficult we had to face (other drive configurations may be easier to set up). Other administrative features borrow from Berkeley Standard Distribution (BSD). OSF/1 V2.0 is currently shipping and shows further movement towards SVR4 and includes a Logical Volume Manager.

*The single-processor
DEC 3000 held its own
against multiprocessor
competition but would likely
fall short as the center
of a large network.*

A quirk we ran into was that the DEC 3000 Model 800S does not support the use of the Esc key. This key is vital in vi, which is the standard Unix text editor for editing programs, scripts, and other text; vi is a mainstay for any systems administrator. You have to use the Ctrl-[key sequence

for the ASCII sequence sent by the Esc key or, according to Digital, try Ctrl-F11. Apart from DEC OSF/1 Unix this range of servers also supports Open VMS.

On our Mixed Query test the DEC 3000 Model 800S's performance earned

it fourth place, a position it shared with IBM's RISC System/6000 POWERserver 590. It achieved a maximum throughput of 110 tps at 16 workstations. It came in below most of its peers in the Processor Query test with a maximum throughput of 72 tps. You should recognize, however, that with the exception of the IBM sys-

tem, the single-processor Digital entry was competing against multiprocessor machines costing many times more. The results of the Read-Intensive Query test were steady but not very strong. The system might have profited from hardware striping of data across the disks.

As a single-processor machine the DEC 3000 Model 800S held its own against the multiprocessor competition, although it did not perform as well as the IBM POWERserver 590 with its single POWER2 CPU. For database applications Digital probably needs to do more than concentrate on increasing the clock speed of its processors; it needs to put more thought into its other system components. —Mark Jonikas

Hewlett-Packard Co.

HP 9000 Series 800 Model G70

Hewlett-Packard's \$102,000 HP 9000 Series 800 Model G70 was the winner on our Mixed Query test—a tribute to its HP PA-RISC processor and architecture.

The HP 9000 family spans 20 models that meet a range of client/server requirements. The F class servers are aimed at small offices, while the G, H, and I classes can be scaled up to support thousands of users. The basic format is either a desk-side unit or a larger, mid-height cube-shaped case. Expansion can be done either through a processor board upgrade or by means of expansion slots.

This speedy machine, which HP designates a "business server," is powered by two HP PA-7100/96 RISC chips, each with 1MB of instruction cache and 1MB of data cache. Both caches are two-way set associative. The PA-RISC chip contains no internal cache but is designed on a modular basis, which allows HP to make incremental modifications to the chip's components. An unusual feature of the chip—which testifies to its business orientation—is extremely fast integer support for decimal data. Although decimal data is used frequently in commercial applications, it is generally handled poorly by most RISC processors.

Data transfer between the PA-RISC chip and memory is managed by the Processor Memory Bus through a 32-bit multiplexed address/data bus. The 80-

▶ FACT FILE

DEC 3000 Model 800S AXP Desk-side Server

List price (tested configuration) \$42,456

Configuration: DEC Alpha AXP 21064/200 CPU, 256MB RAM, 2MB write-back cache, seven Digital RZ28 2.1GB hard disks, Digital RZ26 1.05GB hard disk, two Digital Fast SCSI-2 disk controllers, DEC RRD42 CD-ROM drive. **In short:**

This system packs a powerful chip that managed a solid performance on our CPU tests. These test results are especially impressive considering that this unit was competing mostly with multiprocessor systems. Configuration was not easy, but some may overlook that since the DEC 3000 Model 800S AXP Desk-side Server offers the lowest price in this roundup.

Digital Equipment Corp.; 800-344-4825; fax, 800-842-7027.

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SUITABILITY TO TASK

Expandability **FAIR**

Transaction processing **FAIR**

Decision support **FAIR**

Ease of administration **FAIR**

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▶ FACT FILE

HP 9000 Series 800 Model G70

List price

(tested configuration):

\$102,000

Configuration:

Two HP PA-7100

RISC/96 proces-

sors, 256MB

RAM, 2MB

cache per pro-

cessor, one 2.0GB HP A3087A SCSI hard disk, seven 1GB HP

C3037U Fast-Wide SCSI-2 hard disks, HP 2869A Fast-Wide

SCSI-2 disk controller, 1.44MB floppy disk drive, HP C2477S

2GB DDS Digital Audio tape drive. **In short:** Hewlett-

Packard's dual-processor HP 9000 Series 800 Model G70

server was the top per-

former on our tests,

enhanced by a speedy

memory subsystem and

excellent scalability

Hewlett-Packard Co.,

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SUITABILITY TO TASK

Expandability **GOOD**

Transaction processing **EXCELLENT**

Decision support **GOOD**

Ease of administration **EXCELLENT**

nanosecond ECC memory is accessible via a 72-bit channel with a maximum throughput of 384 megabytes per second.

In its standard configuration the HP 9000 Series 800 comes with 32MB of RAM, 500MB of disk storage, and four high-speed HP Precision I/O Bus slots. This configuration starts at \$76,000. The system we tested sells for \$102,000 and had 1GB disk storage and 256MB of RAM out of a maximum of 768MB; it also included a redundant power supply and four I/O slots. Consequently it could support only three network cards in addition to the controller required for the disk drives, but this limitation should not cause a problem in typical usage.

HP's Precision I/O Bus allows access to peripheral components via a 32-bit channel at up to 32 MBps. Our system came with a total of eight drives: one internal 2GB drive with the operating system on it and seven external 1GB HP drives combined in a disk array communicating with a Fast-Wide SCSI-2 controller. The HP 9000 Series 800 supports up to 144GB of disk storage. The top of the range in this series will support 330GB.

HP-UX 9.04 is HP's version of Unix; based on SVR3, it incorporates features

from BSD 4.3. It supports SMP and the Logical Volume Manager; the latter helps system administrators set up partitions to spread data over many drives more easily. Most system administration tasks can be accomplished using SAM, HP's implementation of the menu-driven sysadm program found in SVR4. OSF/Motif 1.2 is available as a user interface. HP boasts 7,500 PA-RISC software applications worldwide based on HP-UX.

The HP 9000 Series 800 placed first on both the Mixed Query test and the Processor Query test. On the Mixed Query test, it managed a peak of 216 TPS—30 percent higher than its nearest rivals: Compaq and Data General. What made this performance even more impressive was that HP did not use the Logical Volume Manager to stripe the drives but instead stayed with the manual software striping made available by Sybase. Scaling between one and two processors produced excellent results, yielding a performance improvement of 49 percent with the additional processor. The HP 9000 Series 800 placed first on the Processor Query test, with a peak throughput of 145 TPS. On the Read-Intensive test it came in third, after the Compaq and IBM units, with a peak throughput of 46 TPS.

Hewlett-Packard's professionalism was evident in the support we received from its staff during our tests. It was also clear that HP's in-house database support staff maintained good contact with database vendors.

The HP 9000 Series 800 was the star performer among the contestants. The only disadvantage we could see was that buying it locks you into HP's own proprietary brand of Unix, which could be a problem if you are running other RISC systems within your company's network.—Mark Jonikas

IBM Corp.

RISC System/6000 POWERserver 590

IBM's \$142,422 RISC System/6000 POWERserver 590 was the top-performing single-processor application server in this roundup; it also managed to top many multiprocessor systems on some of our tests. IBM's POWERserver 590 is a mid-range deskside server. The RS/6000 series

ranges from the \$4,000 M20 POWERstation to the high-end POWERserver 990, whose base configuration costs \$127,000. Four of these 990s can be clustered to generate computing power that begins to compete with some of today's supercomputers.

The RS/6000 series is based on IBM's home-grown POWER2 (Performance Optimized With Enhanced RISC) architecture, which serves as the basis for the PowerPC processor. The circuitry needed for the superscalar design was too complex to fit onto a single chip; hence the processor ended up as an eight-chip module that consists of a fixed-point chip (with two units), a floating-point chip (with two units), 32K of instruction cache, four data cache units totaling 256K, and one storage control unit. Under ideal conditions, this intricate architecture allows six instructions to be executed per clock cycle. However, the complexity incurs several disadvantages: Coordination between the chips limits the speed of the POWERserver 590's processor to 66 MHz; also, the multichip design is expensive to manufacture, which is reflected in the price of the entire system. The POWER2 circuitry consumes 60 watts and dissipates a lot of heat; it comes with a fairly massive heat sink, and the case has six fans.

The POWERserver 590 is housed in a double-width tower case that comes standard with a CD-ROM drive, 64MB of RAM, a SCSI-2 controller, and two 1GB drives. Our configuration added a 1.44MB floppy disk drive and an 8-mm tape drive. Of the eight Micro Channel slots, seven were occupied by a pair of SCSI-2 controllers, a high-performance graphics adapter, and the Ethernet boards we needed to communicate with our test-bed. The system we tested came with 256MB of RAM, but the 590 can support a total of 2GB of RAM.

Disk storage consisted of three 2.4GB drives mounted internally, supplemented by an IBM 9334 external SCSI unit that comes in a standard-width tower case. The IBM 9334 drive system contains an additional three 2.4GB units and one 1.37GB unit. The 2.4GB units are unusual in that they are actually two drives sitting on a single spindle but accessed by two independent arms. Total storage in our unit amounted to 15.8GB.

IBM uses AIX 3.2.5 Unix as an operating system, which is an SVR4 derivative that uses its own Journaled File System. It includes a Logical Volume Manager, SMIT (System Management Interface Tool), and AIXWindows—a Motif-like windowing environment. The Logical Volume Manager allows the system administrator to stripe a file system across several drives. SMIT is one of the best Unix system administration tools we have seen. Available both in text-based and windowing environments, it is organized intuitively and allows the administrator much control over the file system. AIX 3.2.5 does not yet support SMP, although IBM is currently working toward that end.

The POWERserver 590 gave its most impressive performance on the Processor Query test: It was a close second to the dual-Alpha processor HP 9000, which outperformed it by only about 8 percent. It stayed well ahead of the rest of the field, which included many multiprocessor machines. On the Mixed Query test, the POWERserver 590 came in behind the HP, Data General, and Compaq units; it gave a maximum throughput of 112 tps.

The POWERserver 590's perfor-

mance on the Read-Intensive test, however, was uneven. At eight workstations it came in second after the Compaq, with a spurt that took it to 54 tps, but its performance deteriorated substantially after that. Initially the POWER server 590 performed poorly on this test, apparently because of brief power failures and possible power spikes on the disk controller. IBM's response was nothing short of spectacular. On the following day, IBM shipped us an entirely new system and brought in engineers to examine the problem. The cause turned out to be trivial—the shipping department had taped diskettes onto the power fan located at the rear of the machine—but it was the quick turnaround that impressed us.

This powerful and easily configurable machine holds much in store for the future. The processor gave ample proof of its horsepower, and we can expect even better performance when SMP machines become available.—Mark Jonikas

AT&T Global Information Solutions

AT&T 3455

AT&T Global Information Solutions, formerly NCR Corp., moved away from its strategy of using proprietary chips and operating systems in favor of an open systems policy based on using Intel chips and standard operating systems.

The AT&T 345x series supports Unix, Windows NT, and DOS. Another series, the 34xx, aims for workgroups and can support up to six Pentiums. The more advanced 357x series targets the departmental level and can support up to 32 Pentiums. The AT&T 3455 we tested cost \$67,805 and came with four Pentiums/60s.

Under ideal conditions, each of Pentium's two instruction pipelines would allow the chip to double the performance of a 486 chip. The Pentium uses 8K of internal cache for instructions and has another 8K of internal cache for data.

The disadvantage the Pentium has to live with is its heritage: Maintaining its compatibility with software written for its CISC predecessors means forgoing some of the advantages that true RISC processors can exploit, such as the use of a fixed-length reduced instruction set.

To make memory access faster, the AT&T 3455 uses dual-ported memory and two-way interleaving. It has EDAC (error detecting and correcting), which finds and fixes single-bit errors in memory,

and detects and also reports two-bit errors. The test configuration came with 256MB of RAM.

The AT&T 3455 server is housed in a classic deskside cabinet. The processors come on two dyadic boards, each of which holds two Pentium/60 chips, together with 256K of external cache and cache controllers. A separate board carries the system memory. I/O is channeled through an enhanced Micro Channel bus that has a maximum throughput of 80 megabytes per second. Seven 32-bit Micro Channel slots are available; in our configuration, they were partially filled with four Ethernet cards and a SCSI adapter.

The sleek tower case has room for up to 11 internal drives. Our system came with eight Digital drives mounted internally, each with a capacity of 1.05GB. Additional disk storage can be added with an external chassis. The input devices installed on our system included a 1.44MB floppy disk drive and a QIC tape drive. The system has a 720-watt power supply and also comes with an uninterruptible power supply.

AT&T's Unix of choice was SVR4 MP-RAS. This is a classic SVR4 system with AT&T-added MP-RAS, which includes the Veritas Journaling File System and the usual sysadm systems administration tool. During our testing we made use of the Virtual Terminal Manager available within MP-RAS. This allowed us to hot-key between different sessions.

Since the machine was preconfigured

*IBM's POWERserver
gave ample proof of its
processing horsepower.
We can expect better
performance with
multiprocessing machines.*

▶ FACT FILE

RISC System/6000 POWERserver 590

List price (tested configuration): \$142,422
Configuration: POWER2/66 CPU, 256MB RAM, 256K external cache, three 2.4GB IBM 2590 hard disks, one 1.37GB IBM 2570 hard disk, IBM SCSI-2 High Performance I/O disk controller with 512K cache, 1.44MB floppy disk, IBM 6146 8-mm tape drive, IBM 2600 CD-ROM drive. **In short:** IBM's single-processor RISC System/6000 POWERserver 590 server not only outperformed many of the multiprocessor units in this roundup, it also includes an impressive and highly useful set of system administration tools.

IBM Corp., 800-426-2255, fax, 800-426-4329

489 on reader service card



SUITABILITY TO TASK

Expandability	FAIR
Transaction processing	FAIR
Decision support	FAIR
Ease of administration	EXCELLENT

► FACT FILE

AT&T 3455

List price (tested configuration): \$67,805

Configuration: Four

Pentium/66 processors, 256MB RAM, 256K write-back cache per processor, eight 1.0GB Digital Equipment Corp. DSP 3105 Fast SCSI-2 hard disk drives, AT&T 54C700 disk array controller with 1MB cache, TEAC FD235 1.44MB floppy disk drive, Archive Viper 2525 525MB tape drive, Sony CDU-561 CD-ROM drive. **In short:**

Although the AT&T 3455 sported four Pentium processors (and can support up to six), its performance on our tests was uninspiring, hampered by a poor-performing disk subsystem.

AT&T Global Information Solutions, 513-445-5000

490 on reader service card



SUITABILITY TO TASK

Expandability	GOOD
Transaction processing	FAIR
Decision support	POOR
Ease of administration	EXCELLENT

for our use, we had no problems setting up for testing. We had an opportunity to set up serial communications for modem access and were impressed by how easily the system can be configured. At the start of the boot operation, the AT&T 3455 performs extensive diagnostic tests. The systems administrator can interrupt this process to boot with an alternative operating system or to update firmware if necessary.

This system was unfortunately one of the most disappointing performers on our server performance tests. On the Mixed Query test, the best throughput achieved by the AT&T 3455 was just 70 tps at a load of 12 workstations—less than half the transaction load of the Hewlett-Packard system. On the advice of AT&T technicians, we set Sybase to use three of the system's four CPUs as Sybase engines. We also performed runs with one and two Sybase engines to see how the system scaled with additional processors. The scaling achieved by additional processors was less than optimal, with the best improvement occurring between one and two processors.

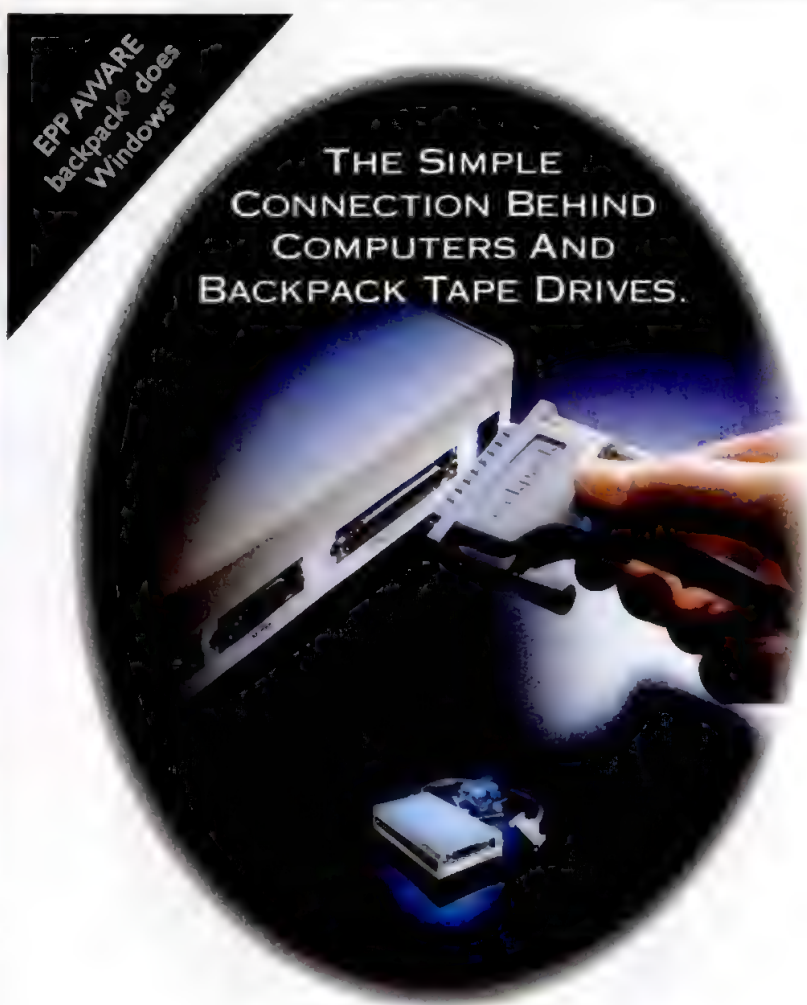
Using three processors, AT&T 3455

yielded a maximum throughput of 63 tps on the Processor Query test. This was a poor showing, especially when compared with the Compaq, which achieved a peak throughput of 90 tps with just two processors. The discrepancy can probably be explained by the difference in efficiency of access between memory and the CPU in the two systems. The Read-Intensive test also gave subpar

results.

The AT&T 3455 was one of two Pentium-based systems that we tested. With four Pentiums on board it turned in a disappointing performance, hampered by poor disk performance. However, we have to compliment the support staff for their accessibility and helpfulness during our testing process.

—Mark Jonikas □



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NOVELL DOS 7

MS-DOS* 6.21

KEY FEATURES	NOVELL DOS 7	MS-DOS* 6.21
Disk compression	YES	NO
Multitasking	YES	NO
Memory management	YES	YES
Protected mode drivers	YES	NO
Workstation security	YES	NO
Backup & Antivirus	YES	YES
Built-in networking	YES	NO

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Life *After* DOS

Which 32-bit operating system will carry you into the future? It's a choice you can't put off much longer.

Are you still running DOS? By all indications, the DOS era is drawing to a close—and that includes DOS used to bootstrap 16-bit Microsoft Windows. It's high time to choose a successor.

Waiting in the wings are a host of 32-bit operating systems custom-built for your 32-bit Intel processor. Their sophistication makes DOS look like a toy. Some of these operating systems have decades of history behind them, while

By David S. Linthicum

others are new creations less than a year old. As rival vendors loudly stake their claims, it's important to realize that the 32-bit field is still wide open. The desktop and server requirements of your organization, not the sales pitch, should determine the environment that best meets your needs.

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OUR REVIEW LINEUP

This story covers 32-bit operating systems now commercially available for Intel processors. We limited our selection to operating systems that ship with a graphical user interface and sup-



EDITORS' CHOICE

• OS/2, Version 2.1

port both true preemptive multitasking and multithreading.

On the Unix side, we looked at Interactive Unix, Version 4.0, from SunSoft; Nextstep, Release 3.2 for Intel Processors, from NeXT; Novell UnixWare, Version 1.1, from Novell; SCO Open Desktop, Release 3.0, from The Santa Cruz Operation; and Solaris for x86, Version 2.1, also from SunSoft. We did not include Consensys, a System V 4.2 Unix that has not had a major revision since it was last reviewed (for more information, see "The Beast Turns Beauty," June 15, 1993).

Among non-Unix systems, we reviewed IBM's OS/2, Version 2.1, and Microsoft Windows NT, Version 3.1. We also looked at an early alpha version of the next release of Windows NT (project Daytona), which we discuss in the Windows NT review. For information on Microsoft's upcoming 32-bit successor to 16-bit Windows, see "Chicago: Under Construction," in our issue of April 21, 1994. IBM provided us with background information on upcoming OS/2 releases (for details, see the sidebar "The Future of OS/2") but no prerelease products.

THE 32-BIT EDGE

What are we running today? For the vast majority of users, Windows has won the battle for the desktop, although many of us still use DOS. Applications for DOS and Windows are plentiful, relatively inexpensive, and meet our needs. Yet both DOS and Windows are 16-bit operating environments that can't really leverage the 32-bit processors inside our systems. Neither DOS nor Windows delivers true protected-mode operation, a flat memory model, real multitasking, or support for multithreading. Clever workarounds for emulating these features have long existed but they are notoriously unstable—especially in Windows—or highly proprietary.

Why go 32-bit? Because 32-bit operating systems offer features that harness the true power of Intel's highly evolved

Buying an advanced OS is like buying a house: You can't do without one, but even the nicest ones force you to live with compromises. Our choice goes to the operating system we feel currently offers the most on the plus side—with the smallest number of drawbacks. Our

Editors' Choice designation goes to IBM's OS/2, Version 2.1. This operating system impressed us with its stability, its true object-oriented GUI interface, and strong DOS and Microsoft Windows emulation. OS/2 is far less hardware-intensive than most of the other reviewed operating systems, running comfortably with 8MB of RAM, even on a 386. This and its low price make it a strong candidate as a corporate desktop standard.

Additional high points include OS/2 2.1's implementation of SOM, a powerful language-independent object model; and REXX, IBM's cross-platform procedures language. Naturally, there are downsides to consider as well. Although native OS/2 applications remain in short supply and hardware support is still limited, at this point in time OS/2 is your best bet.

An honorable mention goes to SCO

processors. One of the most fundamental of these is protected-mode operation. This is the operating system's ability to take advantage of a hardware-protection scheme that has been built into Intel processors since the 80286. The OS implements a series of protection rules that keep user-level software from interfering with important system elements. When your misbehaved application crashes, it can't bring down the OS. Windows 3.1 can implement some protected-mode features but needs to switch to 8086-compatible real mode for many operations, leaving it vulnerable to crashes.

The 32-bit operating systems also manage memory in a much more simple and effective way than DOS. Memory is accessed using a "flat" model—a single unified 4GB address space. Gone are the hassles with upper memory, high memory, extended memory, expanded memory, add-on memory managers, and all the quirks and trials that have driven users and programmers bonkers for years.

Preemptive multitasking is another standard feature of all 32-bit operating systems. An operating-system scheduler is responsible for divvying up processor time between all the tasks that the computer needs to handle. This equitable system is in contrast to Windows 3.1's cooperative multitasking, in which the application itself is responsible for giving up control. Obviously, an application that doesn't yield control brings the whole system to a crashing halt.

Multithreading is another important 32-bit plus. Applications are written in *threads*, defined as the smallest units of independently executable program code. The operating system can multitask at the thread level so that applications can juggle a number of tasks independently. Threading can improve the performance of database servers and other heavyweights significantly. Multithreading also means that you'll spend less of your day waiting for the hourglass icon to disappear before you can issue your next command.

Many 32-bit operating systems also support symmetric multiprocessing, the operating system's ability to take advantage of more than one processor in a single computer. The OS handles this by dividing threads between the available processors. When your processing needs increase, you

Our Contributors: MICHAEL J. MILLER is the editor-in chief of *PC Magazine*. GABRIELLE GAGNON is a systems consultant for the Dreyfus Corporation. DAVID S. LINTHICUM is a network consultant working with Mobil Oil Corp. BRIAN SEIRUP is director of computer operations for the Environmental Defense Fund in New York City. THOMAS MACE was the editor in charge of this story, and JAY MUNRO was the project leader.

Open Desktop, Release 3.0. Although it is based on an aging version of the System V kernel, SCO Open Desktop offers a highly stable server platform for a broad range of LAN environments. Its huge stable of line-of-business applications and large installed base are a testament to its strengths.

We were impressed with Microsoft Windows NT, Version 3.1, an OS that offers Unix-like cross-platform and multiprocessing support in addition to its solid architecture and familiar Windows GUI. The upcoming release (code-named Daytona), which we tested in alpha for this story, holds the promise of even faster performance and an improvement on Windows NT's already strong network connectivity while demanding less hardware to run up to speed.

can simply add another CPU.

Finally, these systems are frequently portable across processor architectures. Corporations may find it important to deploy a single operating system across Alpha, Intel, MIPS, SPARC, and soon, PowerPC systems. Many of the reviewed operating systems are currently deployed on multiple hardware platforms and more ports are expected.

These advantages don't come for free, however. If you're used to the quick-and-dirty world of DOS, you may find that 32-bit operating systems need more care and feeding. Installation operations can take days instead of hours, and hardware support may be limited to a small selection of the most expensive brands. An even bigger problem can be the lack of available native applications and flawed DOS and Windows emulation. But the tide is turning as both application and emulation issues are solved.

EMULATION ANGLES

If you are planning a move from the 16-bit world, you'll naturally wonder if you can take your software with you. The answer, with some qualifications, is yes. To keep DOS and Windows users happy, and to provide a source of cheap and plentiful applications, all of the environments we

tested provide some sort of DOS and Windows emulation—some better than others.

In OS/2 and Windows NT, DOS and Windows 3.1 emulation are built right into the OS. Both OS/2 and Windows NT can run multiple 16-bit Windows applications in enhanced mode, and performance in both products is quite reasonable.

On the Unix side, things don't look as good. Unix environments fall back on DOS-emulation products such as Insignia Solutions' SoftPC, Locus Computing Corp.'s Advanced Merge, and Phoenix Technologies' VPix. These are Unix applications that emulate the DOS environment, fooling DOS software into thinking that it's actually running under DOS. Performance is generally lackluster and there may be severe limitations, such as the inability to configure a DOS session with extended memory.

There are several Windows-emulation strategies on Unix. The most common is to run actual Microsoft Windows code under a DOS emulator and then run the Windows application under Windows. Here, performance suffers and you'll generally be limited to standard- or even real-mode Windows operation only. Some systems take a different line of attack, bypassing DOS and Windows layers alto-

gether by translating Windows API calls directly into an API that the Unix operating environment (in this case, X Window) can understand. SunSelect's WABI is an example. WABI, which takes its name from Windows Application Binary Interface, currently ships with Solaris for x86 and Solaris SPARC, but claims support for only 13 Windows applications.

Another twist on emulation in a mixed DOS-and-Unix environment is to equip Windows clients to run X Window software. A number of X Window-emulation products are available to do the trick. If your Windows users will be confused by an X Window look and feel, SCO's Wintif, now in beta testing, will make X Window apps look like Windows apps (see the sidebar "Wintif: Unix Code, Windows look").

WELL CONNECTED

Advanced operating systems are born to network. Many of the reviewed products are ready to connect to most existing LANs including Novell's NetWare and Unix's native TCP/IP. In cases where networkability is not included out of the box, good to excellent networking options are available as add-ons.

Unix excels at another form of connectivity that OS/2 and Windows NT

HIGHLIGHTS

32-Bit Operating Systems

SAY GOODBYE to 16-bit, real-mode operating systems for your Intel-based PC. Today's 32-bit operating systems offer true preemptive multitasking and support for efficient threaded applications. They also run your apps in protected-memory areas to limit crash damage when one program goes bad. Some operating systems offer GUIs that work like Windows, while others break new ground with true object-oriented desktop paradigms.

DOS AND WINDOWS SUPPORT is excellent in the non-Unix products we saw, but fair to abysmal in the Unixes. Depending on the Windows-emulation strategy involved, you may

be limited to standard- or even real-mode Windows operation, and you may be able to choose among only a small handful of applications.

NETWORKING COMES NATURALLY to advanced operating systems. But while some offer substantial connectivity out of the box, others make you buy it as an add-on. Unix systems also offer an added twist: multiuser connectivity, usually via asynchronous connections to terminals.

APPLICATIONS are a must. Make sure the software you want is available on the platform you pick. Some operating systems boast broad support. Others are still waiting.

Suitability to Task: 32-Bit Operating Systems

Intel hardware is no longer a liability when it comes to picking an operating system. The choices on the Intel platform address different needs and offer different strengths.

The rating in **application development** indicates each operating system's strengths as a development platform. The API should be robust, accessible, and well documented. Compilers for prominent programming languages such as C, C++, COBOL, and FORTRAN should exist, and the availability of high-level tools such as database-development systems, application frameworks, object libraries, and code generators adds to the score.

Graphics and multimedia explores how strong the operating system's support is for common graphics and multimedia hardware. Does the OS support a wide range of video boards, sound cards, CD-ROM drives, and other multimedia peripherals?

A high score in **business productivity** indicates that a good cross section of native spreadsheet, word-processor, personal-productivity, communications, and other typical business applications is

SUITABILITY TO TASK				
Product Name	POOR	FAIR	GOOD	EXCELLENT
Application development	●	○	○	○
Graphics and multimedia	●	●	○	○
Business productivity	●	●	●	○
DOS and Windows emulation	●	●	●	●
Networking and connectivity	●	●	●	●

available. We also look at the selection of native relational databases and the availability of vertical line-of-business applications.

DOS and Windows emulation is critical in a business environment where users depend on standard applications. How robust and configurable is each system's DOS emulation and how well does it perform compared with the real thing? How stable is the provided Windows emulation, what Windows versions are supported, and in what operating modes?

Networking and connectivity explores how well each OS works in a networked environment. The system should provide multiple protocols and should be easy to set up and administer.

can't handle: **Multiuser connectivity.** Using Unix's multiuser support, you can hook up to 512 simultaneous users through asynchronous connections to terminals, much as you would with a mini-computer. While GUI buffs find character terminals horrifying, multiuser Unix systems excel at tasks such as running point-of-sale terminals, accounting systems, or other transaction-processing applications where beauty and grace are sacrificed for practicality, stability, and low cost. Some of the Unix operating systems also boast huge stables of vertical line-of-business applications for use in these environments.

DEVELOPMENT CONSIDERATIONS

Don't choose an operating system without investigating the available tools for building applications. For example, Windows NT is well-supported by superb tools from the likes of Borland, Microsoft, Symantec, and Watcom. The majority of these include not only C and C++ compilers, but graphical integrated development environments (IDEs), extensive frame-

works, and sophisticated code generators for building UI's or automating tasks such as OLE 2.0 programming. OS/2 has comparable tools from Borland, IBM, and Watcom, but they lack some bells and whistles.

On the Unix side, most vendors bundle in or otherwise offer a development system option for each operating system. If you're coming from state-of-the-art DOS or Windows development tools, you'll probably find these environments Spartan.

APPLICATIONS ANYONE?

Probably the most important feature of any OS is the availability of reasonably priced, good-quality applications. You should check out the availability of standard office applications, heavy-duty server apps such as SQL databases, and specialized line-of-business software. The

mix will vary significantly from environment to environment.

On the Unix side, standard office applications are generally scarce while databases and line-of-business apps are generally in good supply. It's important to note that some Unix environments (such as Interactive Unix and SCO Open Desktop) can run each others' executables.

The following reviews will help you balance the complex equation of basic features, DOS and Windows emulation, networking, development tools, and application availability that these complex products present. Look into what's available; a year from now, you may be wondering why you ran a 16-bit OS for so long.

SunSoft Inc.

Interactive Unix

BY DAVID S. LINTHICUM

SunSoft's Interactive Unix, Version 4.0, is a stable but low-powered Unix OS, based on a suite of Unix products and the aging but well-tested Unix System V, Release 3.2, kernel. Unlike its sister OS, Solaris for x86, Interactive is an entry-level Unix solution that can run on weaker workstations: It only eats up a relatively modest 8MB of RAM and 120MB of hard disk space for a full installation. Even a 386SX processor offers a decent home for Interactive, making it one of the few operating systems we tested that doesn't demand a workstation on steroids.

SunSoft bundles an impressive array of products with Interactive, including X11 and Motif, the Looking Glass GUI desktop manager, the VPix DOS emulator, TCP/IP with Streams and Sockets, and NFS (Network File System). Of all of the Unix operating systems we tested, Interactive supports the most impressive list of devices. On the down side, Interactive may be difficult for the Unix beginner, and it is the only OS in our test group that does not provide acceptable support for Windows.

SUITABILITY TO TASK				
Interactive Unix				
	POOR	FAIR	GOOD	EXCELLENT
Application development	●	●	○	○
Graphics and multimedia	●	●	○	○
Business productivity	●	●	○	○
DOS and Windows emulation	●	○	○	○
Networking and connectivity	●	●	○	○

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Performance Tests: 32-Bit Operating Systems

How We Tested

The Stanford test suite, the core of our performance testing, revealed more similarities than differences among our lineup of 32-bit operating systems, especially in floating-point performance. Overall, the leaders were Microsoft Windows NT, Version 3.1, and Novell UnixWare, Version 1.1, with OS/2, Version 2.1, a close third.

Whatever their initial performance levels, all tested operating systems were able to scale to additional simultaneous processes with relative ease. Among the leaders, doubling the number of processes did not come near doubling the execution time required for the test cycle.

Our standard hardware test platform was a Pentium-based Gateway 2000 P5-60 with 256K of L2 cache and 32MB of RAM. The video card was a Diamond SpeedSTAR Windows accelerator card based on the Cirrus Logic CL-DG5428 graphics controller. Additional peripherals included a 450MB IDE hard disk, an Adaptec 1540B SCSI host adapter, and a Sony CDU-6211-10 SCSI CD-ROM drive.

We installed each tested operating system

using its standard defaults. No special tuning or other configuration changes were attempted unless they were absolutely necessary for normal operation.

THE TESTS

We used the Stanford test suite and the Dhrystone benchmark test, both of which are widely available in C source code. We ported the tests to each operating environment and compiled using the environment's native development system and compiler

defaults. In some cases, we modified the source code slightly to accommodate compiler and operating system differences.

The Stanford test suite measures a computer's multitasking ability by executing copies of itself concurrently, using the Unix fork command (or a Microsoft Windows NT or OS/2 equivalent). The program prints out the average time it takes to execute each process, rounded to the nearest second. In the course of each test, we generated results for 1, 2, 4, 8, and 16 simultaneous processes. The Stanford suite consists of 10 subtests that fall into two groups: Integer and

Floating-Point.

The **Stanford Integer** test group comprises a group of routines that execute recursive operations, nested loops, a bubble sort, and multiplication on integer arrays.

The **Stanford Floating-Point** group performs multiplication of a floating-point array, a Fast Fourier Transformation, and a Mandelbrot set calculation. Reported scores are arithmetic averages of scores for all subtests in each category.

The **Dhrystone** benchmark test is a short synthetic test that simulates integer program-

DHRYSTONE 1.1



ming. It returns results in its own unit of measurement: Dhrystones.

We also tested the available DOS and Windows emulation for each product. When possible, we also installed and ran popular native applications such as CorelDRAW, Lotus 1-2-3, and WordPerfect to look for any possible problems.

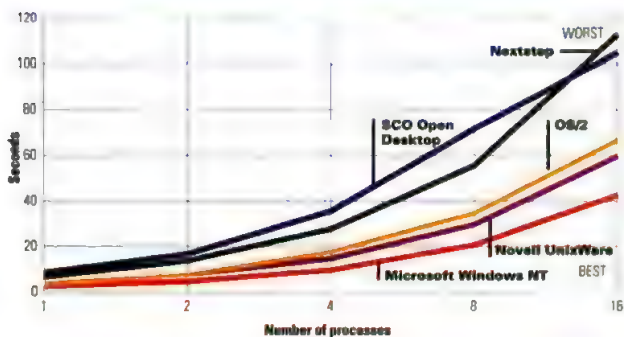
It is important to realize that several variables are reflected in our results, some of which are independent of the operating systems themselves. In particular, differences among the compilers provided with each environment will influence the quality of the binary code used in testing.

WHERE'S SUNSOFT?

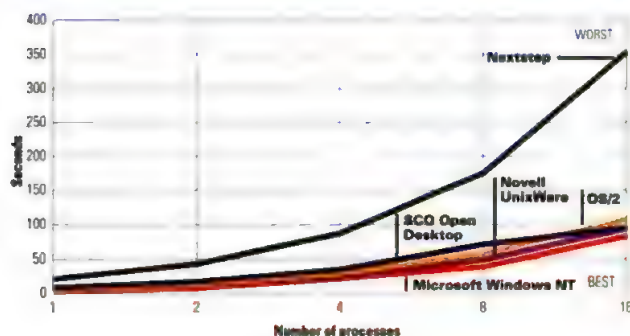
We encountered problems with two of the operating systems covered in this story—SunSoft's Interactive Unix, Version 4.0 and Solaris for x86, Version 2.1—that made it impossible to generate performance scores.

Interactive Unix's development system was not able to compile the code for the Stanford test suite because one of the required header files was not provided in the Interactive Unix SDK. Solaris was not able to run on our Pentium-based test platform due to an incompatibility with our SCSI subsystem. In fairness, neither SunSoft operating system officially supports our test platform.—*Analysis written by David S. Linthicum*

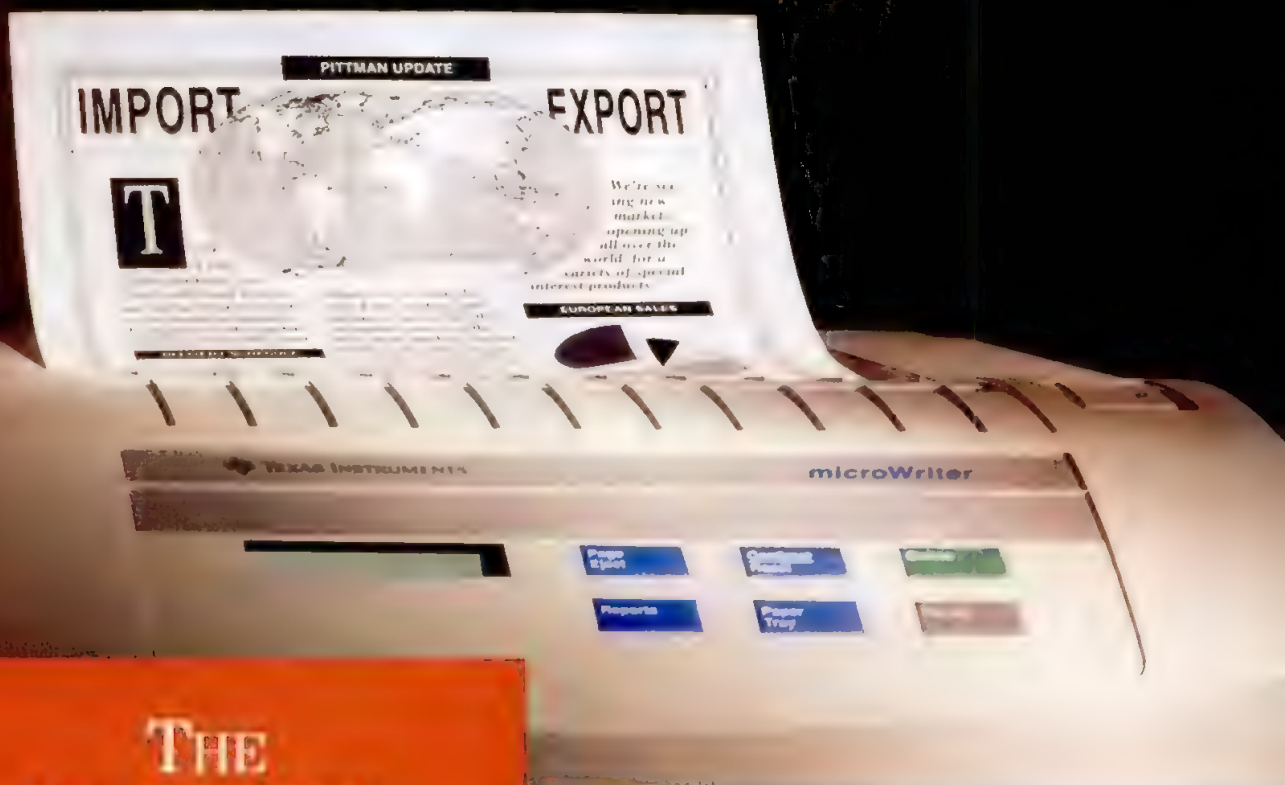
STANFORD INTEGER



STANFORD FLOATING-POINT



Flexibility (flek·sə·bil·ət·ē) *n.* 1. A feature previously not found in this category. *example:* For under \$800, **TI microWriter** printers give you the *flexibility* to start with **Adobe® PostScript®** or add it later; the comparable HP 4L does not.



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If you're looking for a printer with a street price well under \$800*, you'll have a hard time finding one with as many features as a TI microWriter.

Let's compare it to our leading competitor, HP, starting with basic models. First, take flexibility. Ours lets you add PostScript now or later. With the HP 4L you can't add it at all. Take paper handling. Ours comes with a 250-sheet tray standard, theirs with just a 100-sheet. Speed? We give you 5 ppm, they give you 4. Yet in spite of all this, we still list for hundreds of dollars less.

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once again, the TI microWriter is clearly the better value.

For more detailed information or a dealer near you, call **1-800-TI-TEXAS** (1-800-848-3927).

	TI microWriter Basic	HP 4L	TI microWriter PS23	HP 4ML
<i>Print Speed</i>	5 ppm	4 ppm	5 ppm	4 ppm
<i>PostScript</i>	Upgradeable	No	Standard	Standard
<i>Paper Trays</i>	(std.) 250 sheet	100 sheet	250 sheet	100 sheet
	(opt.) 250 sheet	Not Avail.	250 sheet	Not Avail.
<i>List Price</i>	\$599	\$849	\$799	\$1279

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INSTRUMENTS**



Specifications in chart are based on information as of 1994. *Estimated street price. Learn more why TI's microWriter and "Extending Your Reach With Innovation" are trademarks of Texas Instruments. Adobe, PostScript and the PostScript logo are registered trademarks of Adobe Systems. ©1994 TI

STRONG APPLICATION BASE

Interactive is tailored for small to medium-size organizations as a low-cost, multi-user system for application service or as a low-end Unix workstation for industrial use. For those who wish to move up to Solaris sometime in the future, SunSoft provides a compelling Interactive-to-Solaris migration plan and supporting tools.

Interactive boasts an impressive array of native applications. Lotus 1-2-3, WordPerfect, and most major relational database servers are available, including Oracle and Sybase servers. Interactive can run older SCO Xenix binaries, and with the release of Version 4.0, it can run applications developed on either SCO Unix systems or SCO Open Desktop. These applications include Asterix, CorelDRAW, Framemaker, and Wingz. Interactive has also modified both its X11 and TCP/IP products to provide SCO Open Desktop application interoperability. Interactive is a good corporate citizen, complying with major open-systems standards including the Intel Binary Compatibility Specification Issue 2 (BCS-2), FIPS 151-1, Posix 1003.1, and X/Open XPG3.

MULTIPLE SOLUTIONS

With Version 4.0, SunSoft has repackaged Interactive in three distinct platforms: The Interactive Unix Base Solution, The Interactive Unix Network Solution, and The Interactive Unix Graphical Solution. All are available in both two-user and multiuser versions. The multiuser license covers an unlimited number of users, and Interactive can comfortably handle up to 64 connections.

The Base Solution includes the Interactive Unix System V/386 Release 3.2, Version 4.0, operating system and targets workgroups that use character-based, multiuser applications. The Networking Solution adds networking features such as TCP/IP and NFS. This platform is for networked character-based workgroups that need connecti-

ty to host systems or the Internet. The Graphical Solution includes all the software required to get users up and running with a Motif-based GUI. In addition to these bundles, SunSoft offers three products for developers: The Interactive Software Development System, the X11 Development System, and the Interactive Motif Development System.

Interactive is comparatively pricey. The Base Solution lists for \$495, The Network Solution for \$995, and The Graphical Solution for an overblown \$1,195. The multiuser versions of any of these products cost

an additional \$400 each.

The Interactive GUI can be set up to boot directly into a graphical environment that is a mixture of X11, Motif, and the Looking Glass desktop. The Looking Glass Professional desktop manager (from Visix Software) is an X Window-based desktop manager that includes an icon-based, mouse-driven

interface running on top of X11 and Motif.

Looking Glass lets you view files and directories in both text and icon form and navigate through the complex world of a Unix file system with ease. Missing from the environment are applications such as graphics-based e-mail, administration facilities, and other tools that come standard with SCO Open Desktop, Solaris, and UnixWare.

Interactive was the only OS we looked at that had to be installed completely from floppy disks. It comes on about 50 disks and you have to feed every one of them into your floppy drive during installation. The process is otherwise painless and installation takes a little over an hour. And in Interactive's favor, it worked the first time—something not all the tested OS's can boast.

Also to Interactive's credit is its support for a wide range of hardware, including about 150 Intel-based PCs (ISA, EISA, and MCA). Interactive supports over 90 video adapters in a broad range of resolutions, more than 45 disk controllers, 40 network adapters, and 50 tape subsystems. Other Unix systems could learn from this impressive device support.

Interactive provides a Kernel Configuration Link Kit (kconfig) that provides easy-to-use system configuration, kernel linking, and installation. After installing Interactive, you'll need to check kconfig to set the proper memory size and device configuration. If you don't, Interactive will be unaware of some available resources, particularly memory and bus-mastering SCSI devices.

Interactive supports the High Performance Disk Driver (HPDD). HPDD can identify the capabilities built into advanced disk controllers, such as our Adaptec 1540B, and it supports command chaining, multiple seeks, scatter-gather I/O, and SCSI operations. On the network side, Interactive supports products based on SunSoft's Open Network Computing (ONC) for heterogeneous networking. TCP/IP provides the standard protocol that supports the USL Transport Layer Interface (TLI). The Berkeley Software Distribution (BSD) socket interface provides data-transfer services for networked applications. For

With about 150 Intel-based PCs on its roster, Interactive's impressive device support is something other Unix systems could learn from.

▶ **FACT FILE**

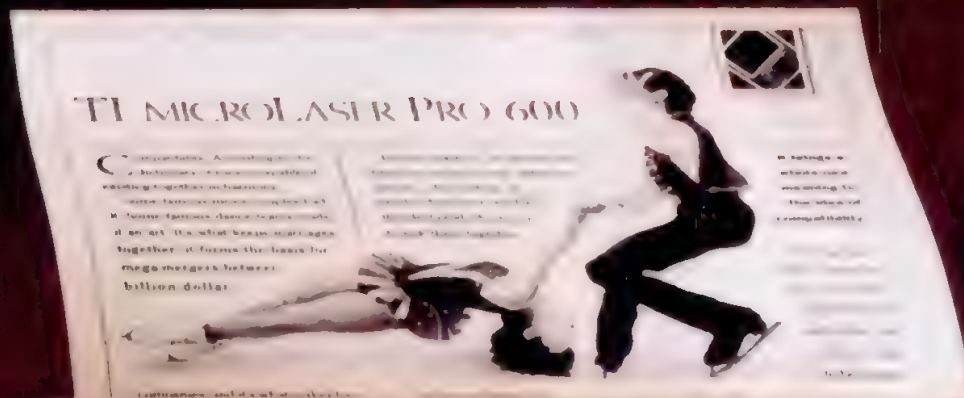
Interactive Unix, Version 4.0
SunSoft Inc., 2550 Garcia Ave., Mountain View, CA 94043; 800-227-9227, 415-960-3200; fax, 415-336-0362



List price: \$495.
Requires: 386SX-based PC or better, 8MB RAM, 120MB hard disk space.
In short: A stable, tested, but aging Unix, Interactive Unix is a no-frills operating system. It offers excellent hardware support and boasts a good selection of native business apps, and its hardware requirements are easier to swallow than those of its competitors. But usable Microsoft Windows support has not yet been delivered, and the package gets unnecessarily pricey if you want to set up everyone in your organization on the GUI. The Looking Glass Professional X Window desktop manager provides the basics but lacks application frills such as graphical e-mail.

 **478** on reader service card

Compatibility (kəm-pat-ə-bil-ət-ē) *n.* 1. A feature rarely found in this category. *example:* The **TI microLaser™ Pro 600** gives you DOS, Windows, Mac, PCL5 and PostScript compatibility standard; HP charges hundreds more.



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about our \$60
rebate*

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REDEFINED.**

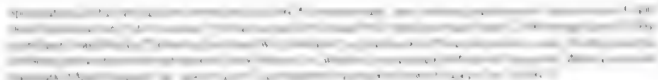
When we set out to design the ideal 600 dpi printer, we asked thousands of users what they wanted most. And then, instead of making those features optional, we made them standard. Take compatibility. We're DOS, Windows and Mac compatible, with all the right languages and interfaces, and the intelligence to switch automatically. Memory? We give you 6MB, for improved graphics. Paper handling? Two 250-sheet trays come standard. And value? As the chart shows, not only do we give you more, we charge

you less. And if blazing speed for heavy graphics printing is required, check out our new 40MHz PowerStep™ upgrade. For more information, call **1-800-TI-TEXAS** (1-800-848-3927).

	TI microLaser Pro 600	HP LaserJet 4	HP LaserJet 4M
Memory	6MB	2MB	6MB
Emulations	PS, ALG, PostScript	PCL5P	PCL5E, ALG, PostScript
40MHz Processor Upgrade	Optional	Not Available	Not Available
Compatibility	DOS, Mac, Windows	DOS	DOS, Mac
Tray Capacity	250 sheets	50 sheets	50 sheets
Paper Trays	250/250 sheet	250/100 sheet	250/100 sheet
List Price	\$1,599*	\$1,899	\$2,499

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remote file sharing over a network, Interactive provides Network File System (NFS), but missing is connectivity to more popular networks such as NetWare.

Interactive also supports the Fast File System (FFS), which radically improves disk file I/O performance via enhancements in the Unix file-system support code in the kernel. SunSoft claims this technology provides sequential file I/O data at rates up to three times that of a standard Unix kernel.

WINDOWS SUPPORT A PIPE DREAM

VPix provides DOS compatibility for Interactive and we used it to run DOS applications such as dBase IV and Lotus 1-2-3 for DOS. Using VPix, you can run multiple DOS applications using a connected terminal, or the virtual terminals that are just a hotkey away. Missing is acceptable support for Windows applications. VPix does not support extended memory, and Windows without XMS is just a pipe dream (you are limited to Windows 3.0 in real mode). SunSoft has announced support for WABI, but no release date has been set.

The Interactive Software Development System provides a C compiler, Source Code Control System (SCCS), and development tools such as make, yacc, and lex. The development system is primitive by DOS and Windows standards, but typical for Unix development at the command line. It also includes the New C compiler, the CodeWatch source-level debugger, and CoEdit, a language-sensitive editor. Documentation for all the Interactive Unix releases is thorough and well-written. Technical support is just a phone call away, and the responses we received were good.

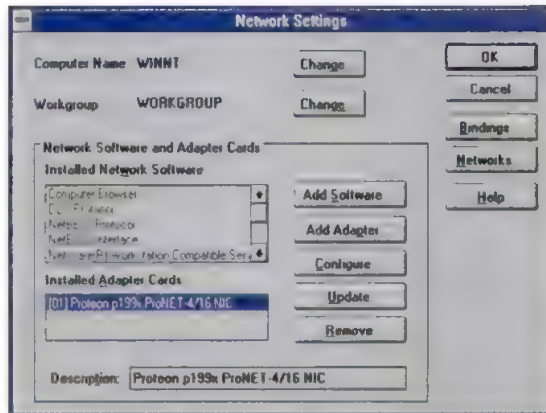
Interactive is a stable Unix product, but it's basic Unix without the frills and the user friendliness—and without some of the problems. To give credit where it's due, Interactive's extensive device support and reasonable hardware requirements should be a lesson to the rest of the Unix world, and application support is outstanding. However, lack of realistic Windows support, bundled integrated desktop tools, and a modern kernel leaves Interactive a lap behind.

Microsoft Corp.

Microsoft Windows NT

BY DAVID S. LINTHICUM

Microsoft Windows NT, now about a year old, is a true preemptive multitasking OS



Easy network connectivity via the graphical interface is just one of Windows NT's many strengths.

that supports multithreaded applications and rivals the capabilities of Unix and OS/2. Not surprisingly, it also delivers almost complete compatibility with DOS, Microsoft Windows, and OS/2 1.x applications. Especially noteworthy features include its multiprocessor support, integrated C2-level security, strong networkability, and cross-platform portability.

The OS comes in two forms: Microsoft Windows NT, Version 3.1, (\$495) intended for the desktop, and Microsoft Windows NT Advanced Server (\$1,495), with added file and application server capabilities. For this review, we tested both the currently shipping version of Windows NT and a prerelease alpha version of the next Windows NT upgrade (project Daytona). This version is slated for release shortly after this article appears.

Judging from our alpha, the Daytona release will not fundamentally change Windows NT but will strengthen the OS's capabilities in several areas including performance, Windows emulation, and network connectivity. Native Windows NT

applications are still in limited supply (most currently available apps are for vertical line-of-business tasks), although Lotus, Microsoft, WordPerfect, and other vendors are porting or planning to port major applications to Windows NT. Microsoft, for one, has committed to ship Windows NT versions of Microsoft Word and Microsoft Excel with the Daytona release.

PORTABLE AND SCALABLE

Unlike Microsoft Windows 3.1 and Chicago (which incorporate significant amounts of assembler), Windows NT is written in C. This, and Windows NT's modular architecture, make it more easily portable across a number of processors. Currently, Windows NT versions are available for Alpha and MIPS chips in addition to the Intel architecture, with a PowerPC version due soon.

The Windows NT kernel supports symmetric multiprocessing (SMP), making it possible to scale performance by adding processors. Because Windows NT distributes each running task on a per-thread basis, the kernel can maximize the effectiveness of a particular processor's RAM-caching techniques.

Each application, including DOS, Win32, and the Windows subsystem, runs in its own address space or virtual machine (VM). If you're running a DOS or Win32

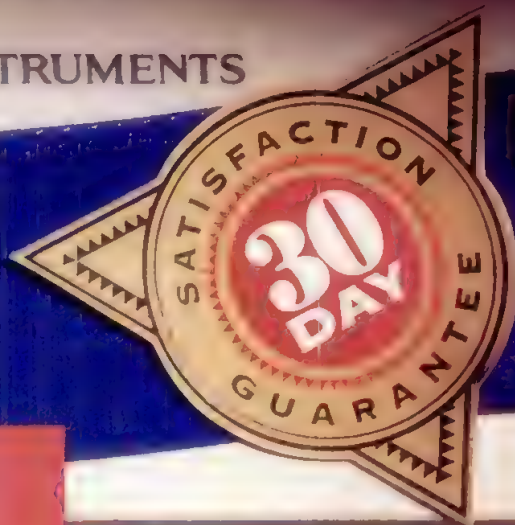
application in one VM, and another application crashes in another VM, this won't bring down your entire system. Windows 3.1 applications are currently executed in a single VM that runs Windows 3.1, and a badly behaved Windows

application can bring down the entire Windows subsystem (but again, not the entire OS). The Daytona release of Windows NT will remedy this situation by making it possible to run Windows 3.1 applications in separate address spaces.

Impressively, Daytona will still let you create DDE and OLE links between these separate VMs. This is handled by a

SUITABILITY TO TASK				
Microsoft Windows NT				
	POOR	FAIR	GOOD	EXCELLENT
Application development	●	●	●	●
Graphics and multimedia	●	●	●	○
Business productivity	●	●	○	○
DOS and Windows emulation	●	●	●	●
Networking and connectivity	●	●	●	○

Satisfaction (sat·əs·fak·shən) *n.* 1. A feature previously left to chance in the purchase of a printer. *example:* When you buy a new TI printer, your **satisfaction** is **guaranteed** or call TI within 30 days and we'll take it back.



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REDEFINED.**

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For additional information about the TI microWriter™ or the TI microLaser™ Pro 600 printers, and for the name of a dealer near you, call **1-800-TI-TEXAS** (1-800-848-3927). And see for yourself how TI is redefining what you should expect from a printer.

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*Offer applies to all new microWriter and microLaser Pro 600 printers, if returned in good condition. microWriter, microLaser and "Extending Your Reach With Innovation" are trademarks of Texas Instruments. © 1994 TI

CIRCLE 304 ON READER SERVICE CARD

16-to-32-bit "thunking" (conversion) layer, which can also handle OLE links between Windows 3.1 and Windows NT programs.

WINDOWS LOOKALIKE

The interface for Windows NT is almost identical to that of Windows 3.1. The only big difference is the appearance of program group icons. As with Windows 3.1, you can also customize the GUI (color, wallpaper, mouse settings, keyboard drivers, and personal program groups). In Windows NT, you can also manage several personal environments for different users of the same system.

The Windows NT Clipboard is an expanded version of the Windows 3.1's Clipboard, with a ClipBook that can store multiple images. The Clipboard can also be shared across a network.

The Daytona release of Windows NT will add a significant enhancement to its graphics resources in the form of OpenGL, the 3-D graphical API developed by Silicon Graphics. None of Windows NT's GUI objects will take advantage of OpenGL, but applications that call OpenGL constructs will be able to take advantage of OpenGL libraries. This positions Windows NT as a serious platform for high-end animation work.

Windows NT can run all DOS and Windows applications using the built-in DOS emulator or the Windows 3.1 subsystem. Unlike many of the Unix-based Windows emulators we tested, Windows NT can run standard Windows apps in enhanced mode. So far, we haven't found a DOS or Windows application that Windows NT can't handle, although DOS applications do seem to run a bit slower under Windows NT.

EASY BEGINNINGS

A full installation of Windows NT doesn't take much more time than a full installation of Windows 3.1. Windows NT comes with a few floppy disks and a CD-ROM disk. Simply load the CD-ROM and respond to a few menu-based questions about disk partitions and subdirectories. Windows NT requires at least 16MB of RAM for acceptable performance, but 32MB or more will make your workstation a real screamer. Our ad-hoc tests on the Daytona alpha suggest that RAM

requirements may be less stringent for the next Windows NT release.

You'll also need about 50MB of hard disk space with an additional 20 to 30MB for virtual memory. Microsoft NT works with most 386 and faster processors and supports most SCSI subsystems and CD-ROM players.

**Microsoft Windows NT,
Version 3.1**
*Microsoft Corp., 1 Microsoft Way,
Redmond, WA 98052; 800-426-9400, 206-
882-8080; fax, 206-883-8101*



List price: \$495
Requires: 386/25-based PC or better, 16MB RAM, 50MB hard disk space (75MB recommended)
In short: An option to be seriously considered, Windows NT is maturing nicely. Its strong capabilities include multi-processor support, cross-platform portability, good performance and networking, and C2-level security. Support for DOS and traditional Windows apps is flawless, though native Windows NT apps have been slow to market. The soon-to-be-released version will improve connectivity, and we expect third-party-application support to improve nicely.

484 on reader service card

As an option, you can leave your existing DOS or OS/2 file system intact and install Windows NT using a multiboot option. At your request, Windows NT can even convert existing FAT file systems to the Windows NT file system. The OS maintains a configuration registry, which is a hierarchical database of configuration information covering hardware, drivers, and software setup data.

Windows NT supports standard DOS FAT, OS/2 HPFS (High Performance File System), and Windows NT's NTFS (New Technology File System). NTFS can roll back bad I/O operations, and it supports filenames of up to 254 characters in length.

The Windows NT networking subsystem is designed around Microsoft's Network Device Interface Specification (NDIS), Version 3.0. NDIS is simply a set of API layers that support various network activities. The Transport Driver Interface (TDI) layer can connect multi-

ple applications and presentation-layer interfaces using individual protocol drivers independently of the network.

Windows NT also uses the Unix-born streams protocol to provide local IPX/SPX, TCP/IP, NetBEUI and DLC support out of the box. Using the IPX/SPX protocol, Windows NT can act as a NetWare client. Windows NT supports FTP and TelNet operations to Unix systems as well. For IBM connectivity, Windows NT can act as an SNA client. The Daytona release of Windows NT will include a revamped TCP/IP implementation that will be included in the base price.

APPLICATION DEVELOPMENT

Although Microsoft offers a Windows NT SDK, serious development probably means purchasing separate tools such as Borland's C++ 4.0, or Microsoft Visual C++ 32-Bit Edition. Native Windows NT applications are written to the reasonably well-documented Win32 API. Microsoft provides excellent documentation with all Windows NT products, and tech support is available via phone, the CompuServe on-line service, or the Internet.

Windows NT can compete with Unix on its own turf and can rival the capabilities of OS/2. Windows NT's multiprocessing and multiplatform support are forward-looking features that should become significant in the next few years. The lack of native applications leaves it less than ideally supported right now, but if promises of binary compatibility between Chicago and Windows NT applications are realized, the number of applications should grow dramatically.

NeXT Inc.

Nextstep for Intel Processors

BY DAVID S. LINTHICUM

It's been just over a year since NeXT Inc. discontinued its trademark jet-black Unix workstations to concentrate on selling Nextstep for Intel Processors, a Unix-derived operating system for the mass-market Intel platform.

Over that year, Nextstep has shown itself to be a pyrotechnical wonder with one of the most intelligent object-oriented GUIs available. It is also a graphics platform par excellence, boasting a uni-

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These systems can easily run today's emerging business-critical applications. They also reflect some refreshing common sense: Namely, there's no reason to downsize from big, complicated computers if you're



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If you're interested in receiving specifications for Compaq systems immediately via fax, all you have to do is call us at 1-800-345-1518, choose the free PaqFax option and request documents #4001 and #4003. And if you think we worked hard at the desk job, wait till you see what we do for you next. **COMPAQ**

■ Wintif: Unix Code, Windows Look

By Brian Seirup

Today, there are thousands of commercial Unix X Window applications that are not available for any other platform. Countless companies have spent millions developing still more. In the public domain and available for free from the X Consortium (a member organization administered by MIT), the X Window system is an important means of providing a desktop GUI while maintaining applications on centrally managed Unix hosts. The popularity of the windowing system has presented some hurdles, however, as users migrate those apps from X Window terminals to PCs running Microsoft Windows.

FUNNY WIDGETS

Running X Window applications under Windows isn't a problem. Hummingbird Communications' eXceed/W, JSB Corp.'s MultiView/X, PC-Xware from Network Computing Devices, Walker Richer and Quinn's Reflection X, AGE Logic's XoftWare/32, and VisionWare's XVision 5 take care of that. The problem is that X Window applications retain their Motif look and feel, even when displayed under Microsoft Windows. That's fine for Motif users but it can leave Windows users wondering what that funny widget is supposed to do. IXI's Wintif, a new middleware product currently in beta, offers a solution.

Wintif (short for Windows-Motif) is designed to give Motif applications the look and feel of native Windows applications. Wintif consists of an enhanced OSF/Motif 1.2 toolkit for Windows, which allows Motif applications to display either in standard Motif mode or in Windows 3.1 mode. Look for Wintif versions for Solaris for x86 and SCO Open Server later this year (IXI is a subsidiary of The Santa Cruz Operation), to be followed by versions for other Unix platforms.

MOTIF EXPLAINED

Motif is the GUI that typically runs on top of the X Window system, though strictly speaking, Motif is not dependent on any particular operating or windowing system. The buttons, text labels, menus, and other interface objects Motif supplies—recognizable by their chiseled, 3-D appearance—behave consistently in any application that uses them. Motif was developed and is licensed by the Open Software Foundation (OSF), an industry consortium sponsored by Digital, IBM, Hewlett-Packard, and SCO, among others. Motif is now the official Unix GUI, thanks to the Common Open Software Environment (COSE) initiative, and it ships with all major desktop Unix products.

Wintif is based on the Motif API but modifies the appearance of the Motif toolkit to make it comply with the Microsoft Windows Style Guide. Since Wintif can be turned on or off by the end user or system administrator, applications can retain their native Motif interface when displayed on an X Window desktop, but can adopt a Windows look and feel when displayed under Microsoft Windows.

There will be two ways to make your application use Wintif. If the application uses shared libraries, you simply add Wintif to your Unix server, where it will replace your existing Motif libraries. If the application is statically linked, you will also need to relink with Wintif libraries.

If you keep an X Window terminal on your desk in addition to your PC, or if you've ever tried running X Window software under Microsoft Windows, you might appreciate Wintif. If your company has a major investment in Windows training and would like to move X Window applications to its Windows users without big retraining costs, Wintif may offer a significant strategic option. □

fied imaging model based on Adobe Display PostScript, and integrating support for 24-bit color, Pixar's RenderMan, and the Pantone Color Matching system. The developers' version, Nextstep Developer, provides one of the finest, most complete development environments in this review.

Before you jump on the bandwagon, there are significant downsides to consider, including Nextstep's small pool of native applications, its stringent hardware requirements, less-than-stellar performance, and perceived lack of momentum. Nextstep is also not cheap. Nextstep, Release 3.2 for Intel Processors and Nextstep Developer, Release 3.2, list for \$795 and \$2,995 respectively.

BERKELEY RADICAL

Among the reviewed Unixes, Nextstep is the radical, with its hooks firmly in the 4.3 Berkeley Standard Distribution (BSD) Unix release and the Mach system kernel. This is in clear divergence from the almost standard Unix System V kernel, now the foundation of SCO, UnixWare, Interactive, and Solaris. Nextstep does provide out-of-the-box connectivity to many standard local and wide area networks, and offers DOS and Windows application compatibility using Insignia Solutions' SoftPC 3.1 for Nextstep (which only provides standard-mode Windows 3.1 support).

Nextstep's stable of native application amounts to a scanty 250, although the list includes a few heavyweights like Lotus Improv, Gupta SQLBase Server, and WordPerfect. It does lack many important applications that Windows users take for granted and that are available in other Unix environments, but most of the applications that ran on old NeXT workstations are migrating to Nextstep. And one unpleasant surprise is that the bundled SoftPC DOS emulator is just a demo version. Making it a permanent fixture of your systems will set you back \$249.

The Nextstep environment includes a number of bundled applications including a rich-text editor and file viewers. Easily the most habit-forming of these is Nextmail, a pioneering multimedia electronic-mail system that supports Rich Text Format (RTF), sound, graphics, and file attachments.

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At only \$2,798

for some stripped down job, either.

It's got an 8MB system memory, 340MB

a full three years.*

One thing's for sure: to catch up with PCs this fast, priced this low, you'd better

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hard drive, a 14" SVGA color monitor—the works.

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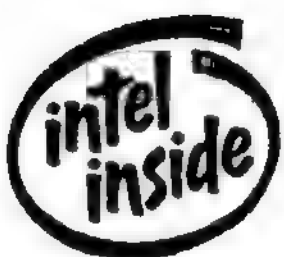
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STUNNING GRAPHICS

Nextstep's graphical interface is nothing short of stunning. The intuitive, 3-D interface sports a black-and-gray, chiseled-steel look that acts as a backdrop to a multicolored wonderland of icons, animation, and multimedia. The Adobe Display Postscript engine provides a crisp and clean look, and the environment's support for high screen resolutions makes the environment shine. In the GUI, you use the directory hierarchy of the file system to locate applications instead of using application groups or subgroups. Nextstep represents each file with an icon automatically, unlike in Microsoft Windows.

Graphics performance is lively due to Nextstep's support for graphics controllers with linear frame-buffer addressing. The package also supports frame buffering to main memory and can bypass the X11 and Motif layers to access video, CPU, and memory resources directly. In contrast to the fast GUI, however, the core system seems to run a few clicks slower at the shell prompt than its other Unix counterparts.

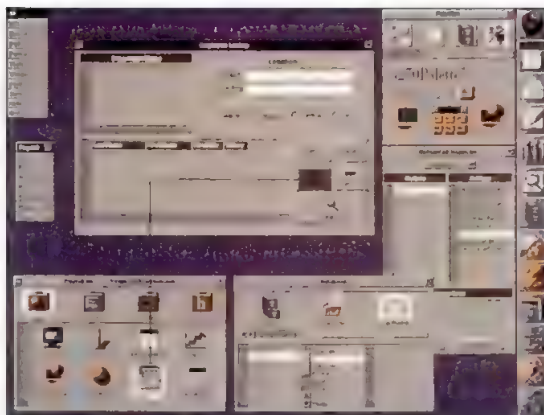
HARDWARE CONSIDERATIONS

Installing Nextstep requires two things: substantial hardware and a lot of patience. You must have a 486 processor and if you have something slower than a 486DX2, you should think twice about joining the ranks of Nextstep users.

Nextstep requires at least 16MB of RAM for basic 24-bit color operation, and 32MB is closer to reality if you want to run more than a few applications concurrently. A 200MB hard disk is also a necessity, but budget for more if you plan to install the development environment and an ordinary number of applications.

The hardware-compatibility list is short and exclusive. Nextstep provides 24-

bit color support for graphics cards based on ATI's 68800 and 68800 AX, Compaq's QVision, Cirrus Logic's GD542x, Tseng Labs' ET4000/W32, S3's 86C805 and



The sleek Nextstep interface still wins kudos as one of the most beautiful and functional GUIs we've seen.

86C928, and Weitek Power 9000 graphics controllers. Using a low-end adapter may limit you to 8-bit or even 2-bit grayscale. Nextstep supports both SCSI and IDE disk interfaces and most major mice, including those from Microsoft and Logitech. It also supports a small selection of good-quality sound hardware.

On the network side, old standards such as the IBM Token-Ring and SMC Ethercard PLUS and compatible network interface cards are supported, as are most 3Com and Intel NICs. Networking is a strong point of

Nextstep. The Mach OS supports object messaging that facilitates intersystem and interprocess communications. Nextstep easily links to NFS running TCP/IP, or you may configure Nextstep to become a Novell NetWare client or a Macintosh AppleShare client. Foreign file compatibility is built in, with support for DOS and Macintosh file conversion.

Installation of Nextstep is a breeze, but it's a long breeze. Nextstep comes on CD with a boot floppy disk supporting most major SCSI host adapters and CD-ROM drives. After booting, the installation program needs a few responses from you—then it's off and running. The total time of

installation depends on the speed of your CD-ROM drive, but don't expect it to take less than an hour of unattended operations. Documentation is adequate for performing basic installation operations, but doesn't offer enough to solve serious problems.

DEVELOPMENT STRENGTHS

Nextstep's development environment is one of its greatest strengths. Nextstep Developer, based on Objective C, C++, and ANSI C, includes comprehensive object frameworks and an impressive array of tools for developing Nextstep applications.

The Application Kit module included with Nextstep Developer offers a set of standard objects to define functionality common to all applications. It also includes a library of GUI objects and objects that support data-sharing applications. For client/server development, a Database Kit is available that supports connections to popular SQL database servers such as Oracle and Sybase.

Nextstep's Interface Builder provides a full-blown drag-and-drop visual-development environment that lets you select interface objects from a database of resources and construct a new interface

SUITABILITY TO TASK				
Nextstep for Intel Processors				
	POOR	FAIR	GOOD	EXCELLENT
Application development	●	●	●	●
Graphics and multimedia	●	●	○	○
Business productivity	●	●	○	○
DOS and Windows emulation	●	●	○	○
Networking and connectivity	●	●	●	○

FACT FILE

Nextstep, Release 3.2 for Intel Processors

NeXT Inc., 900 Chesapeake Dr., Redwood City, CA 94063; 800-879-6398, 415-366-0900; fax, 415-780-3714

List price: \$795

Requires: 486-based PC or better, 16MB RAM (32MB recommended), 200MB hard disk space (300MB recommended)

In short: With Adobe Display PostScript, support for true 24-bit

color, and a desktop design unparalleled in the industry. Nextstep is the most visually stunning operating system you can own. Its object-oriented developers' environment and built-in applets such as multimedia e-mail put it a generation ahead of its competitors. It all comes at a price, however. The package itself is expensive, the hardware requirements are prohibitive, and application support is somewhat worrisome

on reader service card



APPLICATIONS DEVELOPMENT

32-Bit Operating Systems

for a Nextstep application. Third-party objects are available covering tasks from 3270 communications to animation.

The fact that the core OS is object-oriented makes it possible to extend system functionality cleanly. For example, if you add OCR capabilities to the print object, all of the Nextstep applications that make use of the print object will have the ability to use the new OCR capabilities.

Nextstep is an exciting environment. The design and presentation of the object-oriented interface put the product in a class by itself, and the development system is a programmer's dream. On the downside, the small number of available native applications and the stringent hardware requirements are disheartening.

Novell Inc.

Novell UnixWare

BY BRIAN SEIRUP

The company Univel now belongs to history. The latest release of UnixWare ships under Novell's banner as Novell UnixWare, Version 1.1. This should help dispel some confusion over who's in control of the product line and it underscores UnixWare's most distinctive capability: out-of-the-box connectivity to NetWare servers for both native Unix applications and for DOS or Windows applications running under emulation. The new release also adds the Motif window manager, incorporates X11R5 windowing technology, and rolls in TCP/IP networking and DOS and Windows emulation—all into the base package.

DUAL VERSIONS

UnixWare 1.1 ships in both application-server and single-user versions. The list price of the UnixWare 1.1 Application Server has been substantially reduced from the original \$2,495 to \$1,299 for unlimited users. The limited, two-user UnixWare 1.1 Personal Edition lists for \$249, making it competitive on the desktop with OS/2. And like OS/2, the Personal Edition is positioned as a high-performance, 32-bit, multitasking desktop platform able to run your favorite DOS and Windows applications. The Application Server, on the other hand, is posi-

tioned as a departmental multiuser system, as an economical database server, or for vertical line-of-business applications.

NETWORKING

NO SURPRISE

Not surprisingly, UnixWare 1.1 provides excellent connectivity to NetWare servers for all UnixWare clients. It supports both the TCP/IP and the IPX/SPX protocols for Ethernet or Token-Ring. It offers automounting for NetWare file systems, NetWare auto-authentication, and access to NetWare services via the NetWare C API.

It does not, however, provide NetWare-compatible file or printer services for PC clients, though Novell says it may offer "NetWare for UnixWare" (which will probably be a version of Portable NetWare) at some future date. Of course, UnixWare can provide standard Unix file and printer service to any DOS clients running TCP/IP and NFS, but this doesn't seem to be the emphasis. Instead, UnixWare is delicately positioned as a complement to NetWare, not as a replacement for NetWare.



UnixWare's GUI is unadorned Motif but it offers good desk accessories and an Open Look interface toggle.

An especially nice feature is UnixWare's Veritas fault-resilient, journaling file system (VxFS), which is the default file system for hard disks. Unlike the standard System V file system, the Veritas file system will not be corrupted if the system halts abnormally. Recovery from a system fail-

SUITABILITY TO TASK

Novell UnixWare

	POOR	FAIR	GOOD	EXCELLENT
Application development	☐	☐	☐	☐
Graphics and multimedia	☐	☐	☐	☐
Business productivity	☐	☐	☐	☐
DOS and Windows emulation	☐	☐	☐	☐
Networking and connectivity	☐	☐	☐	☐

high-performance file system that provides software-based RAID and exceptional on-line configuration capabilities. Support for multiprocessor Intel systems has been announced but is not yet available.

APPLICATIONS

Although UnixWare 1.1 does not enjoy the huge application support of some competitors, most of the major relational databases are available including Informix, Ingress, Interbase, and Oracle. Native productivity apps include CorelDRAW, dBASE IV, Lotus 1-2-3, and WordPerfect 5.1.

Since UnixWare 1.1 can run binaries created for SCO Unix and SCO Xenix, most well-behaved SCO-Unix applications will run under UnixWare 1.1. In this case, *well-behaved* means taking nothing for granted about the operating environment.

For example, you must be explicit about the locations of files and directories and the names of various devices and services.

Because it is sold and supported through NetWare channels, UnixWare 1.1 should enjoy an edge in markets already dominated by NetWare. In fact, some independent software developers see the package as a way to crack the Novell market with their Unix applications. But UnixWare 1.1 still has such a tiny share of the Unix market that end users cannot always count on full support from

developers. You'll probably get fewer surprises if you stick to mainstream applications that are actively supported for the UnixWare 1.1 environment.

UnixWare 1.1's graphical user interface, an unadorned implementation of Motif, is less aesthetically appealing over-

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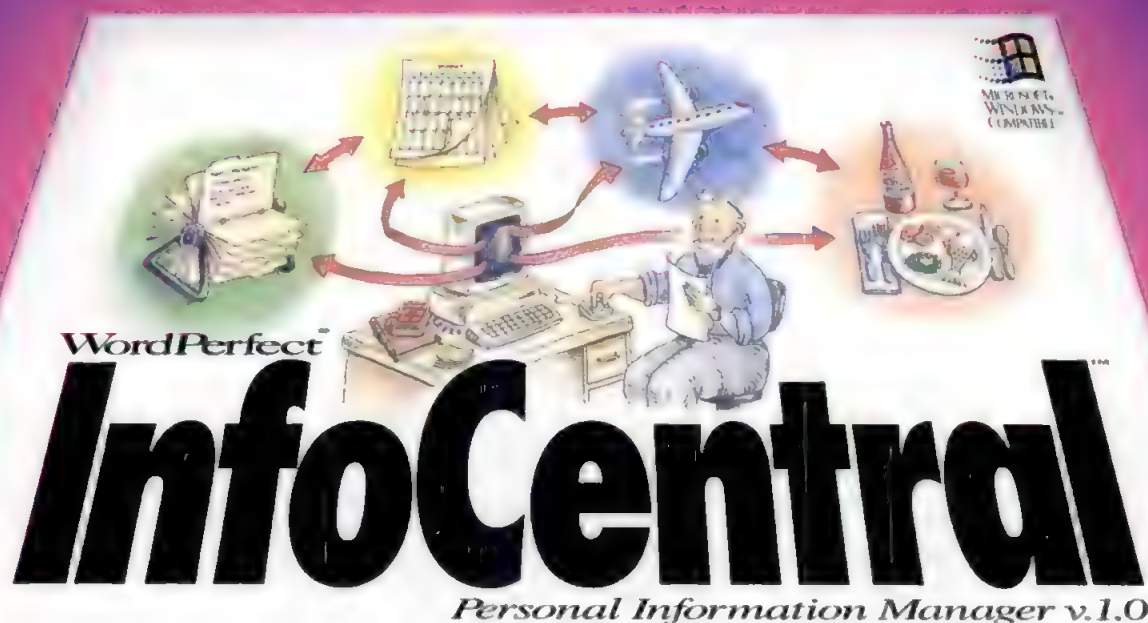
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all than many of the GUIs we looked at. Still, it has many nice features, including interchangeable Motif or Open Look interfaces, and Adobe Type Manager with 17 Adobe Type 1 scalable fonts in standard DOS format. Desktop accessories include a clock, a calculator, a text editor, e-mail, terminal emulation, and games; most system administration can be done using the GUI.

Even your shell programs can take advantage of the GUI using the Windowing Korn Shell (wksh), which, though not as well-documented or easy to use as Microsoft Visual Basic, is nonetheless a useful tool. If you want to change the colors of your screens, however, your choices are limited, and only the default background color lets you see the 3-D effects you need to tell which buttons are up and which are down.

THE DOS AND WINDOWS SIDE

Both the Personal Edition and the Application Server now include Locus Advanced Merge. This provides DOS emulation and the ability to run Windows 3.1, although you are limited to standard mode Windows only.

DOS and Windows emulation are pre-configured with the IPX driver and the proper driver for your network card, as determined during the initial installation.

DOS sessions, by default, go out and look for NetWare hosts on the network. The automatic network configuration is exemplary, and we would hope to see this level of integration in all operating system products.

Unfortunately, we ran into some serious problems running Windows under UnixWare 1.1's DOS emulation. For example, *zooming*—jumping from a windowed to a full-screen session—while reading a floppy disk caused the system to lock up irreversibly. Pressing Ctrl-Alt-Del while in DOS or Windows generally crashed the entire system as well. Even in Motif, without running Windows or DOS emulation, repeatedly pressing Ctrl-Alt-Del would sometimes bring the whole system down. You probably would not want to give users access to the console or to DOS emulation on a mission-critical UnixWare 1.1 server.

SETUP

The interactive part of the UnixWare 1.1 installation procedure is nicely done. After admiring the initial full-screen UnixWare logo, you go through a question-and-answer session in which you specify the installation type and certain basic operating parameters, such as the user name and the current time. This completed, the procedure moves directly to partitioning the hard disk and copying the operating system from CD-ROM or other media. The ability to install UnixWare 1.1 over the network from another Application Server is especially handy.

Installation of extension products like TCP/IP and NFS, however, is complicated somewhat by the deficiencies of the installation guide. The technical writing is pretty rough, and in certain instances, the instructions refer to manuals that do not ship with the product. Often, the missing information proved to be crucial. Getting technical support from Novell also turned out to be quite difficult, even after we identified ourselves as PC Magazine Labs.

Despite these shortcomings, UnixWare 1.1 offers some considerable strengths. If you run a NetWare shop and wish to migrate your NLM server applications onto a more robust environment, UnixWare offers an inexpensive platform that fits naturally into your existing LAN.

FACT FILE

Novell UnixWare, Version 1.1

Novell Inc., 2180 Fortune Dr., San Jose, CA
95131; 800-486-4835, 408-729-2300



List price: Personal Edition, \$249; Application Server, \$1,299

Requires: 386DX-based PC or better, 12MB RAM (16MB recommended), 100MB hard disk space

(140MB recommended)

In short: A speedy and streamlined Unix desktop, Novell UnixWare is a good choice when price and NetWare connectivity are primary concerns. The Personal Edition is targeted for desktop users who want a 32-bit multitasking platform, while the Application Server is positioned as a departmental multiuser system or as an economical database server. Basic native applications are available.

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APPLICATIONS DEVELOPMENT

32-Bit Operating Systems

► SUMMARY OF FEATURES

32-Bit Operating Systems



Products listed in alphabetical order

■ = YES □ = NO

	Interactive Unix, Version 4.0	Microsoft Windows NT, Version 3.1	Nextstep, Release 3.2 for Intel Processors	Novell UnixWare, Version 1.1	OS/2, Version 2.1	SCO Open Desktop, Release 3.0	Solaris for x86, Version 2.1
List price:							
Basic package	\$495	\$495	\$795	\$249	\$249	\$1,195	\$795
Basic package, unlimited users	\$895	\$1,495	N/A ①	\$1,299	N/A ①	\$3,195	\$5,995
Developer package	795 (SDK)	\$495 (SDK)	\$2,995	\$99 (SDK)	\$139 (SDK)	\$1,595	\$995 (SDK)
Architectural Features							
Operating-system kernel	SVR3.2	Windows NT	Mach	SVR4.2	OS/2 2.1	SVR3.2	SVR4
Microkernel support	□	■	■	□	□	■	□
Object linking standards:							
OLE/DDE	□□	■ ■	□□	□□	■ ■	□□	□□
Other	None	Common Object Model	Distributed Objects	None	System Object Model	None	ToolTalk
Local file system	UFS	FAT, HPFS, NTFS	UFS	BFS, S5, SFS, UFS, VjFS	FAT, HPFS	Acer, FAT, Xenix	UFS
Posix compliance	■	■	■	■	□	■	■
C2-level security	■	■	□	■	□	■	■
SMP support	□	■	□	□	□	□	■
Graphical User Interface							
Interface	Unix options	Windows	Proprietary	Unix options	Presentation Manager	Unix options	Unix options
X11R4/X11R5 supported	■ □	N/A ②	N/A ②	□ ■	N/A ②	■ ■	■ ■
Window managers supported:							
Motif/Open Look	■ □	N/A ②	N/A ②	■ ■	N/A ②	■ □	□ ■
Other	None	N/A ②	N/A ②	MoOUI	N/A ②	None	None
Desktop managers supported:							
Looking Glass/X.desktop	■ □	N/A ②	N/A ②	□ □	N/A ②	□ ■	□ □
Other	None	N/A ②	N/A ②	UnixWare Desktop	N/A ②	None	None
Interface font standard	PostScript	TrueType	PostScript	PostScript	PostScript, TrueType	PostScript	PostScript
Emulation							
DOS support:							
DOS-emulation product included	VPix	Windows NT	SoftPC	Merge 386/486 for Unix	OS/2	Merge 386/486 for Unix	None
DOS version supported	MS-DOS 5.0	MS-DOS 5.0	MS-DOS 5.0	Novell DOS 6.0	MS-DOS 5.0	MS-DOS 5.0	N/A ①
Support for multiple DOS sessions	■	■	■	■	■	■	N/A ①
Microsoft Windows support:							
Technology employed	VPix	Windows	SoftPC	Merge 386/486 for Unix	Windows	Merge 386/486 for Unix	WABI
Windows 3.0	■ (real mode only)	■	■ (real mode only)	■ (real mode only)	■	■ (real mode only)	□
Windows 3.1	□	■	■	■ (standard mode only)	■	■ (standard mode only)	■
Network Support							
Network protocols included:							
IPX/SPX	□	■	■	■	□	■	□
NetBEUI/NetBIOS	□□	■ ■	□ ■	□□	□□	■ ■	□□
SNA/APPC	□□	■ ■	□□	□□	□□	□□	□□
TCP/IP	■	■	■	■	□	■	■
Other	None	AppleTalk, Pathworks	None	None	None	None	X.25
Development Tools							
Developer version or SDK includes:							
Object libraries	□	■	■	□	■	□	□
C/C++ compiler	■ □	■ ■	■ ■	■ □	■ ■	■ ■	□ □
Pentium optimization	□	□	□	■	■	■	N/A ①
Database libraries	□	■	■	□	□	□	□
Motif development	■	N/A ②	N/A ②	■	N/A ②	■	■
X11 development	■	N/A ②	N/A ②	■	N/A ②	■	■
Other	None	FORTTRAN compiler	Objective C compiler	None	None	None	None

N/A ①—Not applicable: The product does not have this feature.

N/A ②—Not applicable: The product does not employ traditional Unix conventions



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CIRCLE 379 ON READER SERVICE CARD

• The Future of OS/2

By Michael J. Miller

While much has been written about Microsoft's plans for future versions of Windows, IBM's plans for OS/2 have been less well publicized. In fact, IBM plans four new versions of its 32-bit, multitasking, multithreaded OS in 1994. IBM's intention is to add new features as well as extend OS/2's compatibility to a far wider range of machines. Two versions expected in early summer target different ends of the hardware spectrum.

FASTER AND LIGHTER

Personal OS/2 is designed to provide acceptable performance on machines with only 4MB of RAM, and to work significantly faster than the current OS/2 on PCs with 8MB. It will be an entry-level system positioned as an upgrade to the current OS/2 for Windows, and will also be ideal for notebook computing. Like the 1993 OS/2 for Windows release, this product will not ship with Windows emulation in the box but will work with a user's existing Windows code. Unlike the current version, this new release will be compatible with Windows for Workgroups 3.11. Personal OS/2 will also include a minor update to the Workplace Shell user interface, including new colors and new 3-D icons.

AT THE HIGH END

On the other end of the spectrum is OS/2 for Symmetric Multiprocessing, also expected this summer. Demonstrated at Comdex last fall, this version will support machines with between 1 and 16 processors, which can be Intel 486's or compatibles. IBM says this version is designed to support the multiprocessing standards endorsed by Intel for its 486 and Pentium chips, as well as the specific multiprocessing implementations provided by PC vendors, including ALR, Compaq, IBM, and others.

The biggest changes to OS/2, however, come in the next release of the mainstream version of the operating system, expected toward the end of the year. OS/2, Version 2.2, should include a variety of new features to extend functionality and improve ease of use.

OS/2 2.2 should include support for objects that can be distributed across a network, using the distributed System Object Model (SOM) technology. This and a new replication framework would allow applications to use components on remote machines. In the same vein, this release will include OpenDoc, the compound-document specification endorsed by Apple, IBM, Novell, and others. OpenDoc is designed to be compatible with Microsoft's OLE, but is built on the SOM object model and thus has more network features (for more details, see "Getting It Together," February 8, 1994).

The Workplace Shell user interface is also slated for a facelift. The new version is expected to add a dashboard for easy access to applications, as well as an updated notebook metaphor. This new version will also include hooks for security and systems-management software, and is designed to support the Plug and Play specification. While IBM will not bundle C2-level security, it says that several third-party vendors plan such packages by late fall. Also this fall, IBM plans to introduce OS/2 for PowerPC (formerly Workplace OS for PowerPC), essentially a portable version of OS/2 2.1 based on the IBM microkernel.

When all of these versions ship, IBM believes it will support a wider range of machines with a single API than any other major operating system. Later on, in the first half of 1995, IBM plans to add Taligent frameworks to OS/2. □

IBM Corp.

OS/2

BY GABRIELLE GAGNON

Having survived some dark ages since its debut in 1987, IBM's OS/2 is enjoying what could be called a renaissance. The operating system, originally a joint IBM-Microsoft effort intended as the follow-up to the aging MS-DOS, has sloughed off the remnants of its 16-bit graphics engine, dramatically improved its DOS and Microsoft Windows support, and polished performance. Beneath a rejuvenated exterior is still the sturdy multitasking, multithreaded OS/2 that has been waging an uphill battle for the PC desktop.

OS/2 2.0 discarded the Windows-like user interface in favor of the Workplace Shell (WPS), a more object-oriented design that hides the complexity of the operating system behind an intuitive desktop paradigm. Users now work with object such as folders and documents on their desktops instead of with programs. For example, clicking on a document icon immediately starts the application associated with that document and opens that file. Similarly, printing is simply a matter of dragging a document object onto the printer icon.

WPS objects are based on IBM's new System Object Model (SOM) technology. SOM is a multiplatform, language-independent object model that provides a run-time mechanism for dynamically linking objects. It was proprietary in OS/2 2.0, but in Version 2.1 SOM now conforms to broader CORBA (Common Object Request Broker Architecture) standards.

The full OS/2 2.1 package reviewed here (\$249) contains integrated DOS and Windows support, on-line documentation, productivity applications (including a text editor, a calculator, a calendar, various planners, and a modem-communications package), various utilities and diagnostic tools, and even multimedia support. IBM also sells an abbreviated version, called OS/2 for Windows (\$149) for users who already have Microsoft Windows 3.1 installed.

New to OS/2 2.1 are IBM's multimedia extensions to Presentation Manager (MPPM/2). The package includes several



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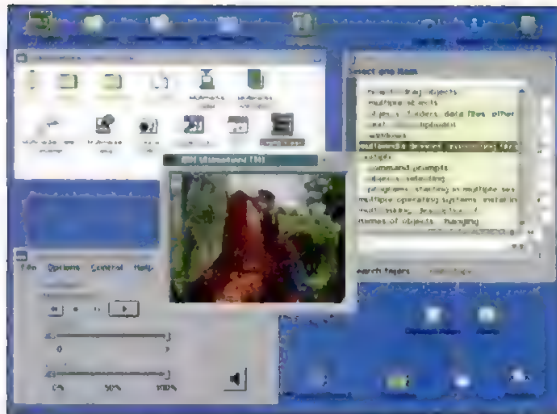
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APPLICATIONS DEVELOPMENT

32-Bit Operating Systems

media players for MIDI recordings, audio CDs, sound files, and even digital movies. While the multimedia additions are nice, MMPM/2 is a first release and is not as stable as the rest of the operating system. The



Media players for MIDI recordings, audio CDs, sound files, and digital movies are new to Version 2.1 of OS/2.

OS/2 2.1 devices worked well but we encountered several problems while playing MIDI files in WIN-OS2 sessions.

INSTALLATION OPTIONS

For an OS/2-only installation, you can format your hard disk using either OS/2's native High Performance Filing System (HPFS) or a DOS-compatible File Allocation Table (FAT) system. HPFS supports filenames of up to 255 characters long and is optimal for large hard disks with large-block I/O. Unlike FAT, HPFS intelligently avoids file fragmentation. HPFS files are invisible to standard DOS, but they can be accessed from DOS or Windows sessions launched under OS/2.

One potential installation trial is locating device drivers for peripheral hardware. Third-party support for OS/2 has improved significantly but it is still far from ideal.

UNPARALLELED CONNECTIVITY

Out of the box, OS/2 provides a number of Interprocess Communications resources (IPCs). IPCs are data-exchange mechanisms that allow separate processes to communicate with one another. Dynamic Data Exchange (DDE) and Named Pipes are two of the most important IPCs. Named Pipes can also establish peer-to-peer communications with other computers on a LAN (including Unix systems), and they are particularly well suited for client-server applications.

To use remote Named Pipes or make other network connections, you will need additional OS/2 requester software. Novell bundles the NetWare Requester for OS/2 with its operating systems, and IBM similarly packages OS/2 requesters with several of its networked products. IBM offers a number of add-on products that enable OS/2 to communicate with virtually every computer—from PCs to mainframes. The most commonly used packages are Communications Manager/2 (\$495) and TCP/IP for OS/2 (from \$295 to \$722, depending on features).

Communications Manager/2, once a component of OS/2 Extended Services, contains protocol stacks for asynchronous communications, NetBIOS, System Network Architecture (SNA), and X.25. It includes link protocols for asynchronous remote communications, Synchronous Data Link Control (SDLC), and X.25 as well as LAN attachments for Ethernet, Ethernet V2, IBM Token-Ring, and PC Network (broadband and baseband). For communications with the Internet world, there is TCP/IP for OS/2. This package provides the complete TCP/IP protocol suite as well as several Unix network services such as MIT's

Kerberos authentication services, Network File System (NFS), and X Window system. With TCP/IP for OS/2, OS/2 2.1 can function both as a client and server in Unix networks.

STRONG DEVELOPMENT PLATFORM

Designed as a model Systems Application Architecture (SAA) product, OS/2 is an enterprise developer's dream. All of its components conform to published, open standards and seamlessly interface with SAA minicomputers and mainframes as well as PC-based systems.

SUITABILITY TO TASK				
OS/2				
	POOR	FAIR	GOOD	EXCELLENT
Application development	●	●	●	●
Graphics and multimedia	●	●	●	○
Business productivity	●	●	●	○
DOS and Windows emulation	●	●	●	●
Networking and connectivity	●	●	●	●

Carefully layered to permit functional independence, the architecture is highly extensible, making it a versatile and flexible server platform. Its ability to handle multiple protocol stacks while running multiple applications concurrently makes it a secure and robust client platform, too.

Over 200 development tools for OS/2 2.x are on the market for numerous languages including Assembler, C/C++, COBOL, FORTRAN, and Pascal, as well as the more esoteric Ada, Modula/2, Prolog, and Smalltalk. REXX, the SAA interpreted-procedures and macro language, is included with OS/2. Several CASE tools and version-control products are available for team development.

Developers who want to extend OS/2's Workplace Shell will want IBM's SOM-objects Developer Toolkit (\$365). This package contains the collection classes, methods, functions, and macros provided by SOM, the framework upon which the Workplace Shell was built. SOM will be the basis for OpenDoc, a multivendor compound-document architecture currently under development.

WHAT CAN I RUN

With the release of Version 2.1 in June of last year, OS/2 has finally delivered on its

FACT FILE

OS/2, Version 2.1

IBM Corp., Armonk, NY 10504;
800-342-6672

List price: on disk, \$249; on CD-ROM, \$219.

Requires: 386-based PC or better, 4MB RAM (6MB recommended), 20MB hard disk space (40MB recommended)

In short: If you're looking for a true 32-bit, multithreaded, multitasking operating system suitable for both desktop and server duty, look no further. OS/2 2.1 delivers a robust platform that offers a user-friendly desktop paradigm, flawless DOS and Microsoft Windows support and excellent connectivity to all classes of computers. Native third-party app and driver support still aren't ideal, but the tide finally seems to be turning.

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32-Bit Operating Systems

promise of complete DOS and Windows compatibility. Most of the bugs from Version 2.0 are fixed, and the WIN-OS2 module supplies full Windows 3.1 support including Enhanced Mode emulation and TrueType fonts. WIN-OS2 performance is smooth and indistinguishable from real Windows; DOS applications run even faster under OS/2 since OS/2 provides more base memory than DOS can. The caveat is that IBM's access to Microsoft code has expired, so OS/2 2.1 may not be able to provide native support for future iterations of Windows.

Perhaps because of OS/2's rocky early history, OS/2 2.1 has not had the support from the industry that fans feel it deserves. There are still relatively few general-purpose business applications available for OS/2, and much of what does exist lags behind its Windows counterparts. But since OS/2 2.1 can run DOS and Windows applications quite well, the lack of native OS/2 applications has not thus far been a serious issue, though it would be nice to see more applications taking advantage of OS/2's unique capa-

bilities. If you are willing to put up with some inconvenience while the market catches up, OS/2 2.1 is a prize.

The Santa Cruz Operation Inc.

SCO Open Desktop

BY BRIAN SEIRUP

At last, the battle for the desktop has been won. As The Santa Cruz Operation (SCO) tells it, Microsoft Windows is the winner. In the world of Unix, however, this statement amounts to heresy. But, while other Unix vendors scramble to compete with Windows, SCO simply acknowledges reality. Its response has been to concentrate on the server side of the market, providing what the company hopes will be the ideal Unix server for the huge installed base of Windows systems.

Accordingly, with SCO Open Desktop, Release 3.0, SCO has split its flagship into two products: SCO Open Desktop and SCO Open Server Enterprise. SCO Open Desktop is a personal system designed for a single user. SCO Open Server offers

exactly the same features in a multiuser system for up to 512 simultaneous users. In both versions, SCO delivers a complete, robust, and flexible Unix SVR-3.2 implementation, with significant enhancements and extensions.

The SCO Open Desktop package (\$1,195) includes the SCO Unix system, the Open Desktop graphical environment, TCP/IP connectivity, C2-level security, DOS emulation, Windows support, and full network services including NFS and IPX/SPX. It can also serve as a LAN Manager client. SCO Open Server includes all of the above and

adds support for 16 users at \$2,195 and 512 users at \$3,195. Both SCO Open Desktop and SCO Open Server can be extended for symmetric multiprocessing (SMP) by adding SCO MPX, which costs \$1,495 for one additional processor, or \$3,495 for three additional processors.

STRONG UNIX APP SUPPORT

As the market leader in Intel-based Unix systems, the SCO Open Desktop family boasts a huge stable of native applications. In addition to thousands of vertical line-of-business apps, you can also find all the major SQL database systems (including Informix, Ingres, Interbase, Oracle, Progress, Sybase, and Unify). And while the selection of shrink-wrapped business productivity software is far smaller than it is for Windows, enough packages exist to make SCO Open Desktop a viable option. CorelDRAW, dBASE IV, FrameMaker, Lotus 1-2-3, Microsoft Word, the Norton Utilities, and WordPerfect Office are all available in SCO Open Desktop versions, and Lotus Notes server and client products are scheduled for release by year's end.

For DOS and Windows support, SCO Open Desktop includes the latest DOS Merge from Locus Computing Corp. The product provides a sturdy DOS-emulation window, includes MS-DOS 5.0, and supports Windows 3.1, although in standard mode only. You'll need to install your own copy of Windows 3.1 to provide the actual Windows environment. We found that most Windows applications ran reliably under emulation, although about 20 percent slower than when running natively.

THE OPEN SERVER CONNECTION

One reason why SCO Open Server makes such a good application server is that it lets multiple users run character-based applications on inexpensive dumb terminals that

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SUITABILITY TO TASK

SCO Open Desktop

	POOR	FAIR	GOOD	EXCELLENT
Application development	●	●	○	○
Graphics and multimedia	●	●	●	○
Business productivity	●	●	●	●
DOS and Windows emulation	●	●	○	○
Networking and connectivity	●	●	●	○

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- ☐ Local Bus Video Controller
- ☐ VGA Video Connector, 256 Colors at 640 x 480; 512KB Video RAM
- ☐ Two Type 2.0 of One Type 3.0 PCMCIA
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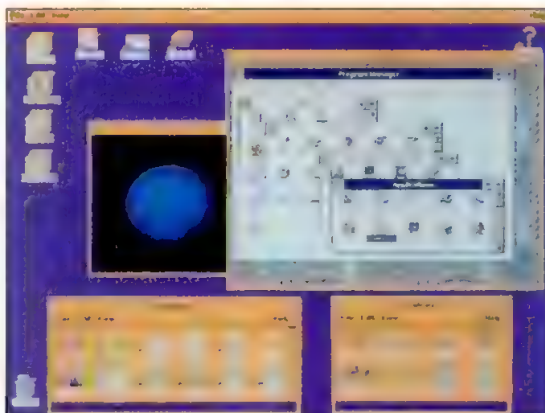
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are connected to the server via RS-232 serial cables. You can also run these applications on just about any PC using a terminal-emulation program such as the one that comes with Microsoft Windows as long as you have a serial connection to the SCO Open Server box.

Purchasing a third-party TCP/IP product lets you run applications on SCO Open Server over the network using DOS and Windows implementations of the TelNet protocol. With TCP/IP on your PC, SCO Open Server can act as your modem, printer, or back-end e-mail server, and as your Internet gateway. If you add NFS or PC-Interface to your PC, then SCO Open Server can be your file server, too.

There are also a number of third-party X Window products for Microsoft Windows, any of which will allow you to run graphical SCO Open Server applications right from your Windows desktop. And, with the soon-to-be-released SCO Global Access on the server, you will be able to think of the entire Internet as just another graphical application running on SCO Open Server. SCO Global Access will cost \$195 as an add-on or \$895 as a complete standalone system. It is to include an

X Window version of Mosaic—the multimedia, hypertext application that lets you point and click your way into vast libraries of commercial and public information located anywhere on the Internet.



SCO Open Desktop integrates Windows apps into the environment by running Windows in a DOS emulator.

For the less adventurous, SCO Open Server incorporates the same NetBEUI networking facilities used in Windows for Workgroups and Windows NT, providing plug-and-play connectivity in these environments. With Microsoft LAN Manager for SCO Systems, SCO Open Server functions as a full LAN Manager server to a Windows for Workgroups network, offering access to a full range of computing resources, centralized management and security, and a client-server applications platform. Available directly from SCO, LAN Manager for SCO Systems costs \$1,295 for 5 users, \$2,995 for 15 users, and \$4,290 for an unlimited number of users.

NetWare clients running NVT (Novell Virtual Terminal) can run Unix applications on SCO Open Server, taking advantage of its built-in support for IPX/SPX and the NVT protocol. But SCO Open Server does not let you mount NetWare volumes as remote file systems. Thus, applications running on SCO Open Server will not be able to see files on a NetWare server unless you are running Novell's NFS, an expensive option. SCO is moving to remedy this fault, however, and will include NetWare client capability in a future release.

PAIN-FREE INSTALLATION

Basic installation for SCO Open Desktop is a breeze, although tasks such as installing

terminals, printers, and modems can become more complex. Once you've answered the initial questions regarding domain name, security parameters, desired video mode, and the like, you can walk away while the setup routine partitions your disk according to your instructions, scans for bad tracks, and creates Unix and DOS partitions. It then proceeds to read the services you want from CD-ROM. The whole process should typically take less than two hours.

The routine for setting up Windows has been simplified: Just click on the special Windows setup icon for a DOS Merge session specially configured for Windows. Setting up the network, e-mail service, and user accounts might require several hours more, though there are good tools to facilitate these tasks. SCO Open Desktop and SCO Open Server include outstanding documentation sets along with extensive on-line help.

The SCO Open Desktop Development System (\$1,595) features a complete set of development tools and libraries, including a Microsoft C compiler, an AT&T portable C compiler, a linker, an assembler, graphical and character-based debuggers, a source-code control system (scs), GUI libraries (X11R5 X Library, X Toolkit, and OSF/ Motif Toolkit), network libraries, and cross-development libraries for DOS, OS/2, and Xenix. A SCO optimizing C compiler for 486 and Pentium processors is available for \$995, and the SCO C++ Language System costs \$595.

Overall, SCO Open Desktop and SCO Open Server earn high marks for their robustness, ease of integration, processor scalability, strong DOS emulation, and reliable Windows support. Both are among the most widely used and universally supported Unixes for Intel-based systems and boast the widest choice of vertical business applications and supported hardware platforms.

If you need a secure, reliable, well-supported platform for high-end desktop or client-server applications, SCO Open Desktop deserves serious consideration. If you need a cost-effective, scalable Unix platform for multiuser applications or a flexible multipurpose Unix server for DOS and Windows PCs, then SCO Open Server is the best available choice.

FACT FILE

SCO Open Desktop, Release 3.0

The Santa Cruz Operation Inc.,
400 Encinal St., P.O. Box 1900, Santa Cruz,
CA 95061; 800-726-8649, 408-425-7222;
fax, 408-427-5404

List price: \$1,195

Requires: 386-based PC or better (486 recommended), 8MB RAM (12MB recommended), 110MB hard disk space

In short: SCO Open Desktop is a very reliable, highly scalable,

truly multitasking OS for the high-end desktop or the mission-critical server. With a fine GUI, a good selection of vertical applications and shrink-wrapped business apps, solid DOS and Windows support, and built-in connectivity, SCO Open Desktop and SCO Open Server Enterprise are the Unix of choice for Intel platforms.

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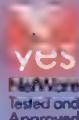
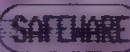
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SunSoft Inc.

Solaris for x86

BY DAVID S. LINTHICUM

Solaris for x86, Version 2.1, is simply an Intel version of the popular Solaris for SPARC operating system. In fact, the SPARC and x86 versions are so similar that most experienced Solaris users won't see the difference.

SunSoft's intention is clearly to offer one high-end integrated operating system across both x86 and SPARC platforms. Its target is the organization engaged in downsizing that is looking for a scalable workstation solution. Is Solaris for x86 the answer? Solaris has a well-thought-out interface with a good collection of tools. However, its brief hardware compatibility list and limited number of applications make it a better choice for SPARC than for x86 systems.

UNIX PEDIGREE

Solaris for x86, like its SPARC cousin, comes complete with SunOS 5.x, a 32-bit Unix operating system based on the System V, Release 4.0, kernel. It also comes with Open Network Computing Plus (ONC+); the OpenWindows, Version 3.x, GUI; and DeskSet, an integrated desktop that includes 15 canned

productivity tools. The operating system supports symmetric multiprocessing using a multithreaded kernel.

Applications compiled for the Solaris SPARC version are useless on x86 chips because of the differing processor archi-

SUITABILITY TO TASK				
Solaris for x86				
	POOR	FAIR	GOOD	EXCELLENT
Application development	●	●	○	○
Graphics and multimedia	●	●	○	○
Business productivity	●	●	○	○
DOS and Windows emulation	●	○	○	○
Networking and connectivity	●	●	○	○

tectures. Wingz, WordPerfect, and other native SPARC applications are not available for Solaris for x86, but all is not lost. Solaris for x86 is compatible with the SVR4 Application Binary Interface (ABI). It also supports the Binary Compatibility Specification (BCS-1), a standard binary interface for applications based on SVR3 (such as SCO Unix, which is based on System V, Release 3.2). This means that Solaris can run applications based on the SVR4 ABI and its x86 processor specification supplement (iABI), or applications based on BCS-1 (with the exception of Xenix applications). Moreover, Solaris for x86 adheres to the SVID Issue 3, API, Posix 1003.1, XPG3, and the X11R4 open standards.

Many of these iABI and BCS-1 applications are available for SunSoft's Interactive Unix and SCO Unix platforms. For example, for DOS compatibility testing, we ran the Interactive Unix version of the VP/ix DOS emulator and it worked fine. However, if you're using applications compiled for other Unix systems, such as SCO Unices or SunSoft's Interactive Unix, don't expect support for Solaris's OpenLook GUI. These are character-based applications only.

The Solaris for x86 applications-compatibility guide lists over 500 products including cc:Mail for Unix, Oracle7, and ObjectStore. Missing are the big-time productivity apps from

Lotus, Microsoft, and WordPerfect.

Solaris for x86 is also expensive. The single-user version lists for \$795 and the Workgroup Server is \$1,995 with support for one or two servers in a workgroup configuration. If you want to run a corporation using Solaris, Solaris for x86 Enterprise Server is a hefty \$5,995 for an unlimited number of users.

A LOOK AT OPENLOOK

Solaris for x86's OpenLook interface and DeskSet productivity tools add up to one of the more elegant GUIs reviewed here. The interface is similar to other Motif-like interfaces we tested, but the addition of DeskSet makes the environment well-suited to handle the day-to-day tasks of a typical workstation user. DeskSet provides a multimedia e-mail facility, a calendar, a file manager, a print tool, a text editor, a clock, a calculator, a tape-management facility, a performance meter, and an icon editor.

Sadly, the OpenLook GUI is dying, a victim of the new COSE standard. For X11-compliant apps, you have to rely on OpenWindows, a full-blown X11 R5 windowing system running under OpenLook that comes bundled with the Solaris for x86 OS. OpenWindows uses Adobe Display PostScript and a distributed windowing environment. It provides workspace managers that offer basic services such as open, close, maximize, and minimize, and tools that let you customize the workspace. OpenWindows also offers support for 24-bit color devices, OpenFonts technology for font development, and the ability to print encapsulated PostScript. For development, Solaris provides graphics libraries that include PEX, XGL, XIL, and Xlib.

FACT FILE

Solaris for x86, Version 2.1
SunSoft Inc., 2550 Garcia Ave., Mountain View, CA 94043; 800-227-9227, 415-960-3200; fax, 415-336-0362

List price: \$795.
Requires: 386DX-based PC or better, 16MB RAM, 200MB hard disk space, math coprocessor.
In short: SunSoft has done a good job of bringing the inviting look and feel of its SPARCstation OS to the Intel platform with Solaris for x86. Solaris for SPARC users won't be able to tell the difference, in fact. But applications for the RISC platform won't run on an Intel box, and Solaris for x86 is missing many of the key big-name business productivity titles. A short hardware compatibility list, steep hardware requirements, and a high price may have you looking elsewhere

 on reader service card



Solaris's OpenLook interface and DeskSet productivity tools add up to be one of the more elegant GUI's around.

HEFTY HARDWARE

You'll need a pretty hefty configuration to play with Solaris. A 33-MHz 386DX CPU with a coprocessor is the minimum you can get away with, and at least 16MB of RAM is required. In reality, don't count on getting Solaris running up to spec with less than 32MB of RAM and at least a 486/DX2 processor. You'll also need a 300MB hard disk and a high-end video adapter.

The installation process is just a matter of booting the install disk and pulling data off a CD-ROM for an hour or so after you've answered a few setup questions. You can configure Solaris for a stand-alone workstation, a dataless boot client, a diskless boot client, or a boot server, depending on your requirements.

If you have a problem installing and configuring Solaris, chances are it's hardware. The package has a short hardware compatibility list, but includes most Adaptec SCSI and DPT SCSI cards, most SCSI and IDE hard disks, but only a few video adapters. Hooking your Solaris workstation to a network limits you to 3COM, IBM, or Western Digital cards. If you want

the product to sing, you'll need a Creative Labs Sound Blaster Pro audio card.

We ran into a compatibility problem with the SCSI adapter on our Gateway 2000 P5-60 test-bed. Although the Gateway was not on Solaris's list of compatible equipment, we can't help feeling that it should have worked with this standard hardware.

Solaris's networking environment is based on SunSoft's Open Network Computing environment. This system includes the NFS distributed file system, which allows Solaris to mount remote NFS server drives. Connectivity with NetWare networks is not provided out of the box.

DOS applications can only run under Solaris if you purchase a copy of SunSoft's VPix DOS emulator, which can run most DOS applications but which does not support Windows. If you want to run Windows apps, you'll need a copy of WABI (Windows Application Binary Interface), which can make a Windows application look like an X Window application to the host GUI.

The Solaris Software Developer Kit (SDK) for x86 provides a good environment for most developers and supports a

number of application types, including Motif, OpenWindows (X11), and ToolTalk. It includes documentation, tools, and sample code. A few SDK extras are Devguide, a GUI builder for rapid user-interface design and code generation, and System V Migration Tools that can evaluate source code changes required for moving from BSD to a System V environment.

Solaris ships with very general documentation. There is on-line help in the form of Answerbook, a manual on CD-ROM. Heavy-duty administrator guides and similar materials are sold separately. Tech support must be obtained through your local distributor. We found support to be good, but don't expect help if you're having problems with unsupported hardware—probably the source of most of your calls.

Solaris's interface and bundled applications are strong points, but overall, it still has some growing to do before it can take its place next to SCO Open Desktop, Nextstep, or Novell UnixWare. Its short hardware-compatibility list and limited number of native applications are problems that most users will not overlook. □



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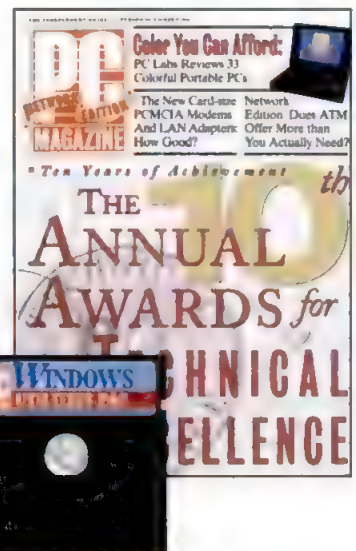
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Is it time for the users on your LAN to reach out and touch someone on another LAN across the city or across the country? They can. Dial-up routers offer an inexpensive way to connect via standard telephone lines.

By Gary Gunnerson

Your jump into wide-area networking holds much the same appeal for your users as local-area networking did, only more so. A WAN extends the reach of users on a LAN to include easy communications with their colleagues on a LAN or LANs many miles away. Productivity is enhanced, the sense of user community is broadened, and opportunities are expanded. So what's not to like?

Until the emergence of dial-up routers, what many network managers of small to medium-sized businesses didn't like was



DIAL-UP ROUTERS

Speaking LAN *to* LAN

Dial-Up Routers

what wide-area networking seemed to mean: complicated, expensive hardware; the messy installation and considerable expense of leased lines to carry data; and loss of control of the network as a whole.

Enter dial-up routers. A great idea for the low-end WAN market, dial-up routers are typically nothing more than small boxes or PCs that are connected to NetWare servers. They usually have two connections: an Ethernet adapter for communicating with a local network and a modem port for communicating with a remote network. These products also include routing software, and dial-on-demand features make connections only when there is information to transmit. These low-end routers have an average cost of about \$2,500.

This class of router should offer a fairly seamless, transparent solution for connecting two geographically dispersed LANs. But like any emerging class of product, this group has its rough spots.

Our overview of dial-up routers from nine vendors reveals that most need refinement. Certainly we noted bright spots, but overall our reviewers encountered cryptic command-line interfaces, nonintuitive setup schemes, and inconsistent implementation of dial-up features.

The features we want to see in this router category include auto-sensing of LAN connection type and addresses, dial-on-demand and line tear-down capabilities, efficient handling of NetWare-specific broadcast packets, as well as standard management functions, such as error logs and alarms.

Our product set includes routers that connect two Ethernet LANs, use standard analog phone lines, and support IPX (NetWare) routing (we noted IP support). We reviewed Livingston Enterprises' PortMaster IRX, the Microcom MBR/6003, NEC America's Dr. BonD-S, Networks Northwest's Breeze 1000, Rockwell International Corp.'s NetHopper NH-P, Shiva Corp.'s NetModem/E, Telebit Corp.'s NetBlazer PN1, 3Com Corp.'s AccessBuilder, and Xylogics' MicroAnnex NCS. (You'll note that router giants Cisco Systems and Wellfleet Communications

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are missing. Both have announced products that fit this category but were not shipping in time for this roundup.)

Our performance testing and feature and management assessment showed that the NetHopper and the Dr. BonD-S offered the best overall choices here. Their easy setup and full-function opera-

tion brought them to the top. They are, however, distinctly different solutions.

The NetModem/E and MicroAnnex NCS both proved too cumbersome to recommend as dial-up routing solutions, mostly because they do not offer automated dial-on-demand connections—a major disadvantage. Each is really better suited as a remote dial-in device. (Without dial-on-demand, the burden of establishing the link—and, more importantly, of remembering to tear down the link when transmission is completed—is placed on end users.)

The modem connection was handled in different ways. The better implemented solutions, such as the NetBlazer PN1 and the Breeze 1000, had a modem integrated into the router. But an integrated unit will be more difficult to upgrade than one with an external modem. Microcom was the only vendor to send us a router with a modem faster than the 14.4-kilobit-per-second (Kbps) V.32bis standard; Microcom sent its own V.fast modem, which operates at 28.8 Kbps.

You can expect router vendors to ship products with V.FC and soon thereafter V.34 modems—if and when V.34 becomes a standard. That's because,

HIGHLIGHTS

Dial-Up Routers

CONNECTING TWO LANS into a WAN can seem intimidating and costly. This emerging class of router is designed to make the task more approachable by using widely available, inexpensive telephone lines. The connections are slower than LAN connections, but they are extremely useful.

ASIDE FROM A FEW of the more well-implemented solutions, these routers lack good interfaces, clear documentation, and easy setup and configuration. These features are essential to products that most likely will be used by relatively inexperienced WAN implementers. Fortunately, they are all moderately priced.

GOOD DIAL-ON-DEMAND and line tear-down capabilities are essential.

Without them, users must initiate connections. A few of these routers do not offer DOD and are better suited as remote-access servers—and are marketed as such.

MULTIPROTOCOL SUPPORT

enhances a router's usefulness. Inclusion in this review required support for NetWare's IPX, but some of these routers also support IP.

LINK MANAGEMENT

and standard network-management features varied greatly. Better products have software that provides a detailed view of the router's status and link statistics. Flexible time-out facilities and good handling of standard NetWare packets also differentiated the routers.



EDITORS' CHOICE

although inexpensive and widely available, a telephone line is a relatively slow medium for information that usually travels locally at speeds of up to 10 Mbps for Ethernet (and 4 to 16 Mbps for Token-Ring).

There are two important distinctions to remember about this class of router. First, many of these boxes can serve in either a routing capacity or as a remote-node server or modem-sharing device on your LAN. And many of the vendors market them as such. A remote-node server acts as the contact point for remote users to connect as nodes on the LAN temporarily (see the sidebar "Routers with Dual Personalities" for more information). The MicroAnnex and Net-Modem/E, in fact, ship with client software that enables a remote user to connect to the office LAN.

Second, dial-up routers are different from branch-office routers, which carry little intelligence and management. A branch-office router leaves management to a sophisticated central router located at a main office site that generally uses a leased data line of some kind. The dial-up routers in this story are "equal" partners connecting "equal" LANs.

WHAT WAS YOUR FIRST CLUE?

Dial-up router solutions work better than the alternatives for scheduled LAN appli-

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- *For dial-up routing*.....**Rockwell NetHopper NH-P**
- *For dial-up routing (with extendability)*.....**NEC Dr. BonD-S**

In this roundup, we were looking for products that would help a network manager with the decision to build his first wide-area connection over the familiar, easy-to-use, widely available standard telephone lines. The NetHopper NH-P, from Rockwell Inter-

national Corp.'s CMC Network Products division, and the Dr. BonD-S, from NEC America, rose easily to the top of this heap of routers based on some strong similarities—good interfaces, easy configurations and setup, and good price-to-performance ratios. These are, however, two distinctly different purchases, each with strengths and advantages we could not ignore.

Rockwell's NetHopper is a very appealing device for answering this basic networking problem. It is supremely approachable, carrying in its small, uncluttered case little more than the ports you need for the job. It offers an extremely speedy installation and a built-in V.32bis modem. For only \$1,695, you get everything you need to connect your two NetWare LANs—including support for Version 3.12's native 802.2 frame type (something NEC did not include).

The Dr. BonD-S, though, in addition to offering an intelligent, well-designed solution for this scenario, appealed to our ever-present sense of "really having somewhere to grow."

cations because, when implemented correctly, they do not require additional applications programming or fiddling with communication scripts. Client/server applications that need relatively little network bandwidth, file transfer, regularly scheduled e-mail delivery, and workgroup applications that replicate when required are all good candidates for the slower, intermittent dial-up links.

A dial-up router makes great sense for a company implementing its first LAN-to-LAN connection that has no installed base of connectivity gear or the need for

This is especially critical in networking. Along with support for connecting over analog lines, you get support for ISDN or Switched 56 services.

In addition, the Dr. BonD-S supports remote access in the same box—in case your LAN universe includes users working away from the office. In either case, you just add the modems. Finally, its performance in our testing was much better than the NetHopper's. Its base list price—\$3,095 (without modem)—seems much higher than the NetHopper's price until you consider what you're getting.

So if you have an overwhelming thought that you'll get into this wide-area networking stuff on telephone lines, only to find you have to move to a faster data line before very long—or if you've got remote users to support—choose the Dr. BonD-S.

But if you're sure you have two LAN sites that you will keep on inexpensive, easy-to-access phone lines, you simply cannot beat the NetHopper's incredible price and remarkable ease of installation. It's a very good buy. □

vendor compatibility. The first-time buyer prefers to start simple and only grow into dedicated communications circuits as applications needs make that financially feasible. Our sidebar on communications alternatives ("What's My Line?") discusses when you should consider moving beyond a dial-up solution and what other options are available.

Finally, we've included a quick look at a few products that offer software-only routing solutions. Each must be installed on a PC or a server on your network, but their software-only nature keeps prices

NETWORKING

Dial-Up Routers

Suitability to Task: Dial-Up Routers

Wide-area networking has broad appeal. Even businesses that have only a few LAN sites would like to make it easier for users to exchange e-mail, transfer files, and share data with users of remote LANs. The use of ordinary telephone lines to make the connection is a real boon for this segment of the market, and dial-up routers make that possible. Because they are far more likely to be used by fledgling WAN managers than by corporate network administrators, dial-up routers require an approachability that has not really been seen in higher-end routers. In addition, the nature of the telephone line itself calls for special management capabilities.

Installation and configuration are particularly important in this product set. We look for a clean setup script to walk managers through installation. This includes a good interface: We consider a

SUITABILITY TO TASK				
Product Name	POOR	FAIR	GOOD	EXCELLENT
Installation and configuration				
File transfer				
Link management				
Network management				

menu-driven interface better than a command-line interface. Any automation of the process is given credit for enhancing ease of use. Particularly useful is when the software can auto-detect the kind of Ethernet connection in use, and when it can auto-sense NetWare IPX and IP addresses. We also look at how users interface with the router—whether by console connection, telnet, or only front-panel indicators.

We assess the router's **file transfer** capabilities in several areas, including speed, quality of bidirectional transfer, and IPX and IP protocol handling. Dial-on-demand features are pertinent here. The router must establish the link automatically. Then the router must tear down the link after a user-

down. (See the sidebar "Soft Sell" for more information.)

INSTALLING IS BELIEVING

The marketing hype surrounding some of these products would have you believe that once they get close to your LAN and a phone line, magic things happen. The reality is that installing them may be your biggest hurdle. In our testing, we looked for a good user interface and quick installation and configuration—which generally meant a good on-screen script to walk you through the process. We saw particularly good implementations from NEC, Networks Northwest, and Rockwell.

To install and configure these devices, you need to set up a communications session or a telnet connection, through which you can set and change parameters on the router. Depending on what the vendor offers, you can do this by connecting the router serially to a PC, which most of these allow, or over the network to a client system. For products that allowed us to connect with serial cable, we used Windows' Terminal program to configure the router.

Most of the routers had RS-232 ports

for connecting, allowed in-band telnet access, or had custom configuration software running from a LAN-attached client. (Telnet is a Unix-based program used in the IP world to log-on and use the resources of another system.) There were a variety of connection options. The Breeze offered an easy configuration tool in its fully configurable front-panel display.

User interfaces ranged from what one of our reviewers called "your standard cryptic router interface"—a command-line affair—to fully articulated GUIs. Devices that rely heavily on their Unix IP roots follow the more common command-line interfaces, while those striving to make NetWare users feel at home offer easier-to-use function keys and pull-down menus. Telebit offered both the best and the worst in interfaces; its Unix-like command-line interface is difficult to work with, and its Windows interface is on the other end of the spectrum.

A well-implemented entry-level router should be able to automatically detect NetWare's IPX network numbers, server names, and IPX routes. And we expect them to auto-sense the active Ethernet port, whether an RJ-45 (10BaseT), a BNC

specified time of inactivity. Users on a LAN should not need to worry about connecting and disconnecting with the other LAN.

Under **link management** we assess the router's abilities to establish, maintain, and otherwise manage the analog-line link. Here we take into account the technical characteristics and quality of the dial-on-demand and tear-down services. We also look at the router's ability for SAP spoofing and for maintaining the SAP tables across the link. And we look for whether the user can configure time-outs. In addition, we evaluate any bandwidth-on-demand provisions.

For standard **network management** issues, we assess the router's ability to give meaningful data for assessing problems. And we observe whether it provides data that would aid in making the decision to move to dedicated or leased lines. We look at the flexibility of the management options, whether by console or telnet, and what kind of hardware each method requires. We give credit for good statistics reporting (link uptime by user, for example), and we look for good error logs. We also note ping, trace-route, and echo capabilities.

(10Base2), or an AUI (10Base5) connection. Several of these routers were able to detect Ethernet ports, and some could detect IPX network numbers.

We also evaluated the products' support of the Ethernet 802.2 frame type, which is the default for NetWare 3.12. Some products, the Breeze 1000, for example, claimed to support it but did not, and others, the Dr. BonD-S, for example, did not provide this required element for the latest Novell offering. (Many vendors plan to build it in to future versions.)

On the TCP/IP side, expect these devices to offer logical prompts for the IP subnet mask. Unfortunately, if you rely on Unix and TCP/IP, your task is much more complicated. Vendors have not found a way to discover everything needed to configure a router automatically in this kind of environment. The NetModem/E and MicroAnnex do not support IP at all, and the MBR/6003 does not support dial-on-demand for IP users.

Finally, we assessed documentation quality. The Dr. BonD-S documentation was the best. It stood out for its clarity and completeness. The documentation across the rest of the group was rather poor. Often

it was confusing—lots of information but little navigational guidance for the user.

HOLD YOUR BREATH

After installing and configuring, we held our breath, flipped the big red switch, and tried to actually use these dial-up WAN links. Most of the routers include dial-on-demand capabilities, which transform an otherwise cumbersome procedure of dialing, synchronizing modems, connecting, and making final communications into the issuing of a simple NetWare attach command at a desktop computer.

One dial-on-demand parameter that requires careful consideration is the inactivity time-out. This determines when the router will tear down the remote dial-up link due to lack of activity. If you set too short a time, the router may tear down the link too soon and cause the device to thrash back and forth, repeatedly tearing down and then reestablishing the link.

An overly long time-out will force you to incur too much in additional connect charges. You'll have to develop a sense of how long of a time-out your application suite calls for and set the parameter accordingly. All of these packages except 3Com's provide a user-configurable time-out parameter; the AccessBuilder's time-out is set for 10 minutes and cannot be changed.

Dial-on-demand does seem to require a bit of magic. Each router must make the local clients believe that the remote server continues to exist even when the dial-up link is not in use. This involves IPX *spoofing* to keep NetWare's Router Information Protocol (RIP) and Service Advertising Protocol (SAP) tables active on servers—even when the Novell routes and services essentially disappear when the link is brought down.

RIPs and SAPs are signals sent out at regular 60-second intervals by NetWare servers to let other servers and routers know that the servers are still connected. Most of the routers were able to keep this information alive for the local clients. The Breeze, however, lost the SAP information over time (the company is working on the problem).

DON'T HOLD YOUR BREATH

Using dial-up telephone lines as your WAN link is admittedly slow, but it is certainly better than what it is usually replac-

analog service Standard telephone service, used primarily to transmit voice messages. Information in digital format must be translated by a modem into analog format in order to be sent over analog lines.

asynchronous transfer mode (ATM) A high-speed data communications standard. It uses fixed-length packets and facilitates transmission at up to 155 megabits per second. Also known as *cell relay*.

bidirectional A type of connection in which communications are sent and received simultaneously. Also known as *full duplex*.

bridge A network device used for forwarding data between two networks. A bridge reads each packet's addressing information, written into the packet at the data-link layer of the OSI model. Unlike a router, a bridge is not interested in the address on the remote LAN, only in whether the packet should be forwarded.

dial-on-demand A dial-up router function that activates a remote link only when data needs to be sent.

internetwork A network of networks

IPX Internetwork Packet Exchange; the network communications protocol that NetWare servers and clients use to communicate with each other.

ISDN Integrated Services Digital Network; a type of all-digital communications service offered by telephone companies. It can carry data, voice, and video.

ping A TCP/IP utility to determine whether or not a particular computer is actively connected to a particular network. A packet is sent out to the network, and the sender waits for an indication that the packet has reached its destination.

PPP (Point-to-Point Protocol) See *Serial Line Internet Protocol (SLIP)*

remote access The process of using a remote computer linked to a local area network via modem. There are two types of remote access. *Remote control* is the process of using a PC as a dumb terminal to access and operate a computer on a

distant network, receiving its video output via modem. *Remote node* is the process of attaching a computer to a distant LAN via modem and having it function as a node. Network packets are transmitted between the LAN and the remote user.

Routing Information Protocol (RIP) The protocol that routers use to exchange information regarding the location of different routers on an internetwork.

router A network device that allows data to be exchanged between networks by using information contained at the network layer of the OSI model.

Service Advertising Protocol (SAP) A standard NetWare broadcast sent by servers every 60 seconds to announce their services, such as file and print.

Serial Line Internet Protocol (SLIP) A communications protocol for linking a PC to an internetwork using a telephone line and modem. The Point-to-Point Protocol (PPP) is more recent and performs the same function. In a more general sense, the term SLIP (Serial Line Internetworking Protocol) can refer to both of these

subnet mask A TCP/IP feature used to extract the network number from a given IP address.

Switched 56 A switched 56-kilobit-per-second service for connecting to any site that also supports Switched 56

TCP/IP Transmission Control Protocol/Internet Protocol. The set of communications protocols commonly used for communication between computers on a wide-area network such as the Internet

telnet A TCP/IP remote-terminal protocol. With telnet, users log onto a remote router or terminal from elsewhere on the network.

V.32bis The ITU (International Telecommunications Union) standard for 14.4-Kbps modem communications.

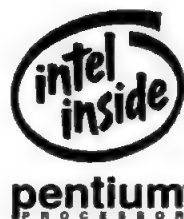
V.34 The ITU draft standard for 28.8-Kbps modem communications, expected to be approved in late 1994.

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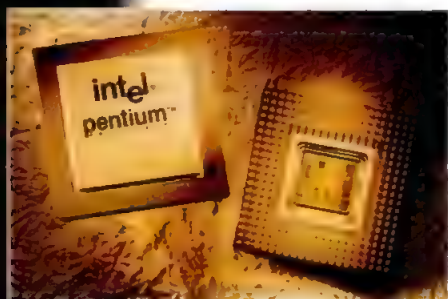
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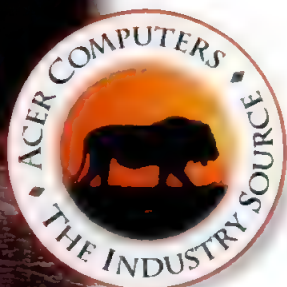
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CIRCLE 087 ON READER SERVICE CARD

ing—either no connection at all or floppy disks sent by overnight courier. And, as noted, higher-speed modems make all the difference—as witnessed by the performance of Microcom's entry operating at 28.8 Kbps. Moreover, all other things being equal, performance is not a differentiating factor for these routers until you introduce compressible files. Then, different compression techniques and the way the router software handles compressed files comes into play.

We tested the routers for handling multiple types and classes of file transfers, both in performance and robustness of the dial-up link. Some bidirectional file transfers proved too much for the BReeze and the PortMaster. Both timed out when activity commenced from both directions simultaneously, simulating a client/server synchronization session. Fortunately, a "retry" response during testing allowed the process to continue.

The modem speed dictates the performance in these tests, with compression schemes having effect on highly compressible files. There is no doubt that the new 28.8-Kbps modems, whether they be V.FC or V.34, will greatly improve your WAN performance. Although we used V.32bis modems in our tests, the one exception—the Microcom MBR/6003—proves the point.

MANAGING YOUR AVERAGE ROUTER

Dial-up routers should help you leverage your WAN technical talent by providing easy-to-administer—and centrally controlled—router management. Our re-

viewers considered the PC terminal and console diagnostic and administrative tools that help you wring the most out of your dial-up router investment.

Most of these devices support the Simple Network Management Protocol (SNMP) reporting and control options, which is a good step. Another good solution for NetWare shops would be the ability to send a broadcast message using NetWare's standard SEND command.

The reviewers also looked at each product's ability to capture error logs and operational statistics. We found few options for tracking dial-up link usage.

Connection information by protocol, usage, and link charges is invaluable in evaluating dial-up strategies.

This statistic could help determine when you need to move to a higher capacity WAN solution. Vendors need to rethink this feature to better handle month-to-month growth statistics. Connect information by protocol, user, total usage, and link charges proves invaluable when it comes time to reevaluate the dial-up strategy.

On the IP front, we expect winning products to handle the legendary *ping* (in which a network device sends out a packet that will return telling it whether another device is reachable) and preferably at least a rudimentary *traceroute* procedure. The NetBlazer stood out from the group for its extensive IP configuration utilities, while the Dr. BonD-S offered good trace utilities available

from easy-to-use pull-down menus.

In addition to router management, managers worry about undesired access to their network. We felt that router password security at the very least would keep all but the most persistent from wreaking havoc. Although many of these units offered dial-back options, we felt that that capability is principally effective for a semi-stationary user to remotely access the system. But if you need a very secure network, the delay inherent in dial-back might be acceptable.

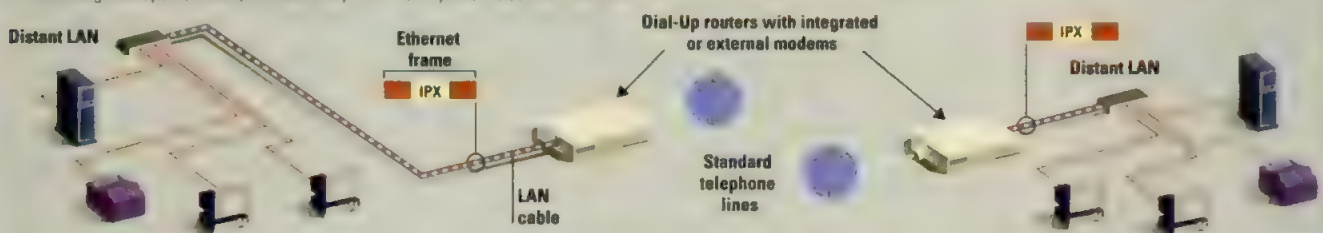
Finally, though this is sometimes initially overlooked, we noted each product's options for upgrading to the latest revision of its operational software. NEC, Rockwell, Telebit, and 3Com offered the most extensive list of software upgrade options. They allow an upgrade by floppy disk, an anonymous FTP transfer (File Transfer Protocol—an Internet route), or an automatic download from a support bulletin board. Networks Northwest also provides an automatic dial-up download into its BReeze router.

WITH BOTH FEET

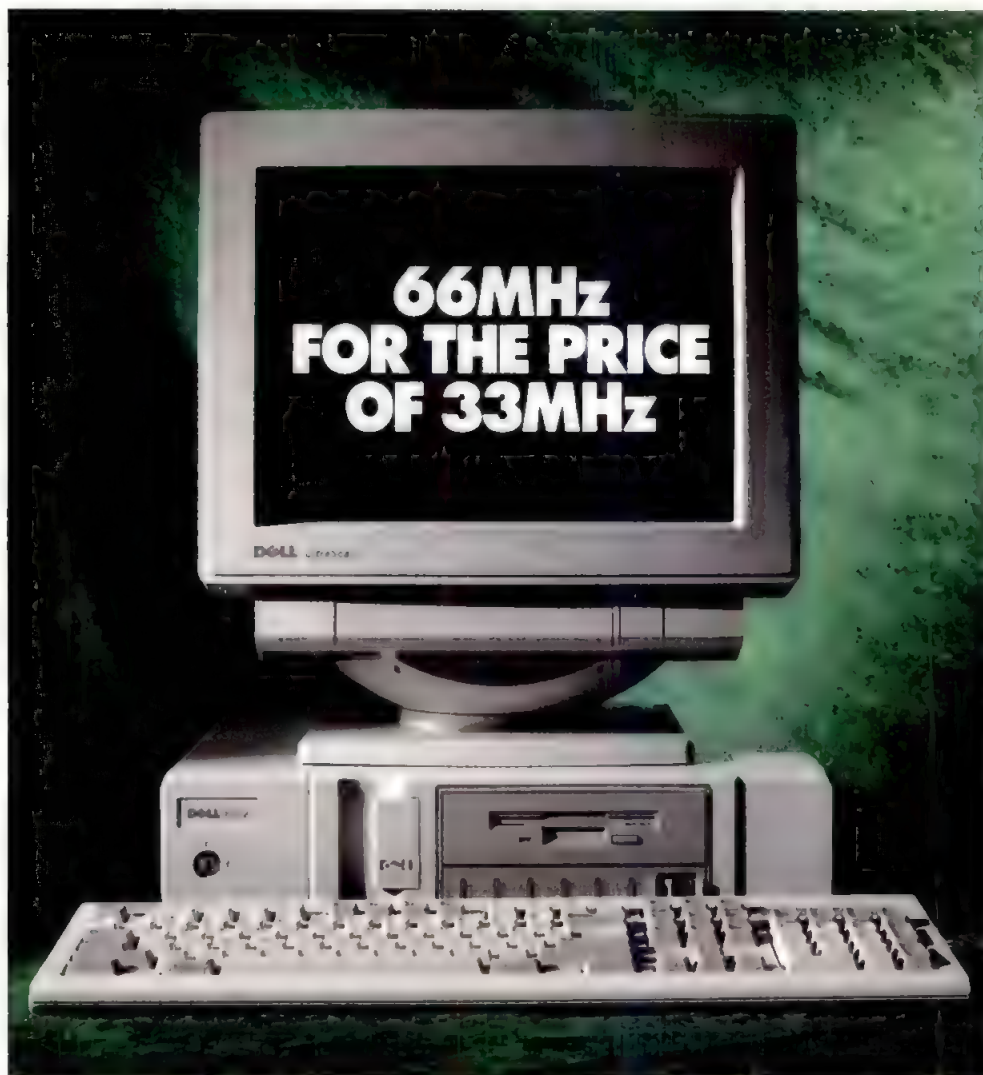
Your first jump into WAN heaven is made a lot easier with this class of routers. You'll be working with the familiar telephone line-to-modem connection and your own networks, and most of these vendors are working on new and better software. There's some work to be done between here and true transparency, but this is a great jumping-off point for organizations wanting to get their feet wet in the world of wide-area networking.

Dial-Up Router Systems

The dial-up router examines IPX or IP addresses in each network frame, discovers those frames addressed to distant LANs, establishes a connection, strips off the outer Ethernet or Token-Ring envelope from each, and sends only the IPX or IP packet across the WAN link



Dial-up routers make temporary links between LANs using standard telephone lines or digital services such as Switched 56 or ISDN. They are particularly useful for file access, e-mail, selective backup, and other short-duration connections. If you use a 28.8-Kbps modem and need links of longer than 3 to 6 hours per day (if you send more than 650MB per month), then a full-period leased-line connection would be more economical.



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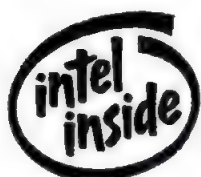
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▪ A Dial-Up Primer

By John Garris

There's no doubt about it. If you buy a dial-up router, you are entering the world of wide-area connectivity.

Why do you need a wide-area link? The transmission schemes used in local area networks, such as Ethernet, are fast, but unfortunately they can't be used to connect networks more than a few hundred yards apart. (The Ethernet standard specifies a limit of 500 meters for the length of a single Ethernet cable segment.) You can extend this distance slightly by using devices such as bridges and repeaters to enhance the signal at certain points. But when you deal with LANs that are many miles apart, you need to use a different transmission scheme to send your data.

Dial-up routers are typically nothing more than small boxes or PCs that are connected to NetWare servers. They usually have two connections: an Ethernet adapter for communicating with a local network and a modem port for communicating with a remote network. These products also include routing software.

Using standard analog modems simplifies the process of establishing the connection. Although they are slow, modems are familiar to most of us, and they are fairly easy to set up. Furthermore, they allow you to use everyday phone lines to transmit data between your local network and the remote site.

Once routers are installed, you can access remote file servers exactly the same way you access local ones. For example, when you type the Novell command SLIST from your client PC, you will see all the servers that exist on both local and remote networks even if the local router isn't physically dialed in to a remote network. And in a drive listing, your drive F: may be on a server thousands

of miles away; you'll hardly know it. Dial-up routers accomplish this by using a technique called *spoofing*; they essentially trick the locally attached clients into thinking that remote servers exist and are connected to the LAN, even if the connection isn't up at that moment.

Once you successfully connect to a remote LAN, you can map drive letters, scan directories, and transfer files as if the remote server existed on your local network. The only difference you will notice is the speed; since these modems run orders of magnitude slower than Ethernet, your response times will be noticeably longer.

These routers, furthermore, ensure that the phone link to the other site is up only when it needs to be. A few of the products force you to dial a remote site manually, using either a DOS or Windows utility, before you can connect to remote servers. Most of the routers, however, automatically dial the remote site when they need to transfer data to a remote server. And when they detect that the phone line has become inactive for a certain amount of time, they disconnect the phone connection.

This feature, called *dial-on-demand*, has two advantages. First, it helps keep your phone costs down because it initiates a connection to a remote site only when it is necessary. And second, you don't have to worry about whether the link is up or not when you try to access remote file servers since the router takes care of everything for you.

In the end, the biggest headache with dial-up routers is their installation and configuration. Once they're up and running, they do most of the work for you, making your wide-area connections as seamless as your local ones. □

Livingston Enterprises Inc.

PortMaster IRX

BY CHUL SUNG KIM

One of the fastest performers in this roundup, Livingston Enterprises' \$2,395 PortMaster IRX has two potential drawbacks. First, it only supports one modem, and second, a potentially more serious problem, it did not finish every file transfer, sometimes timing out before the data had been sent.

The PortMaster provides only one asynchronous port, but it supports up to four synchronous connections for use with dedicated high-speed T1 circuits or Switched 56 digital services. And the router can even open multiple connections between sites as demand for bandwidth increases.

The setup for the PortMaster was not difficult, but it wasn't a model of simplicity either; the documentation is not always complete. The menu-based interface is marred by a somewhat inflexible structure and occasionally inconsistent function-key assignments. (A command-line interface is also provided.) Network managers unfamiliar with TCP/IP may find the configuration screens confusing, as Livingston does not separate the IP and IPX configurations.

The PortMaster features fully customizable packet filtering to selectively limit access across the link in either direction. Making the most of this powerful

FACT FILE

PortMaster IRX

Livingston Enterprises Inc., 6920 Koll Center Pkwy., #220, Pleasanton, CA 94566;
800-458-9966, 510-426-0770;
fax, 510-426-8951

List price: \$2,395 (modem not included).

In short: Designed for network managers comfortable with internetworking, the PortMaster IRX offers excellent performance and many high-end features. However, its limited management capabilities, a less than desirable interface, and repeated problems in our file-transfer testing push it down on the list for the newcomer to wide-area connectivity.



ON READER SERVICE CARD

NETWORKING

Dial-Up Routers



The PortMaster provides only one synchronous port but supports up to four asynchronous connections.



feature requires writing scripts; that in itself will almost certainly scare off casual users. To make matters worse, the script editor is primitive, and no external editor is supported under DOS.

During our tests, we encountered two problems with the PortMaster. First, it repeatedly caused a time-out error on the target client during one of our bidirectional transfers. The failed file transfers were the same as ones encountered with another fast router in our tests, Networks Northwest's Breeze 1000.

The second serious problem we discovered was the router's inability to ignore the security packets NetWare servers send to one another to detect duplicate serial numbers. These packets, coming about once a minute from each

server, caused the PortMaster to initiate a link even when there was no user traffic bound for the remote network—and not to keep the connection when the network was quiet. In order to get dial-on-demand to work correctly, we had to write our own filter to prevent the security packets from going through the PortMaster—an arduous task not required with the other products here.

Unless you have an SNMP management station, the PortMaster offers little in the way of management utilities, at least under DOS or Windows. Statistics are available on traf-

fic through each port, but there are none at all for link uptime. This is a serious omission, especially if you need to evaluate whether to upgrade to leased-line service. (Radius, a utility that ships with the router, provides management from a Unix workstation.) Security against unauthorized initiation of connections is provided by a user table. For greater security, user PCs may be configured for dial-back access, but

this option is more suited for remote computing than for WAN routing.

For the users it wishes to attract, Livingston must address the PortMaster's problematic dial-on-demand capabilities and improve the command-driven interface. Both are factors that may negate any benefits to be reaped from its superior speed.

SUITABILITY TO TASK				
PortMaster IRX				
	POOR	FAIR	GOOD	EXCELLENT
Installation and configuration	●	●	○	○
File transfer	●	●	●	○
Link management	●	●	○	○
Network management	●	●	●	○

■ Of Routers and Remote Access

By Steve Rigney

What's the difference between a dial-up router and a remote-access server? They look alike and generally use the same types of connections—networks and telephone lines. And, in some cases, the equipment is the same; it's just used differently. But although many dial-up routers can perform most of the functions of a remote-access server, in most cases there is a difference in both capabilities and accessory software.

Dial-up routers are designed to link LANs. Their primary function is to call another router on another network over a telephone line and transfer data.

In most cases, the router's firmware has the capability to recognize when the destination address of a specific frame is on a distant LAN. That prompts it to initiate a telephone call automatically. The dial-up router on the other end must

be able to understand the addresses and gather information from routing information packets in order to send the data to the proper destinations. They also include software that tears down the link when transfer is complete.

Remote-access servers, on the other hand, are designed to answer calls from and provide network connections for PCs outside the network. They do not need to have internal dial-on-demand functions. They typically include client software that conforms to the ODI or NDIS LAN adapter driver standard. The software addresses a serial port rather than a LAN card.

Remote-access servers such as DCA's RLN, Shiva's LanRover, and Microcom's LANExpress have multiple ports—a feature found in only a few dial-up routers such as the NEC America Dr. Bond-S. Other devices—such as 3Com's AccessBuilder, Tele-

bit's NetBlazer, Shiva's NetModem/E, and Xylogics' MicroAnnex—come equipped for both roles.

Generally, comparing the costs of these products is as tricky as comparing their features. Shiva's \$1,699 NetModem/E remote-access server, for example, provides a single dial-in and dial-out connection for remote computing, but is also able to plug into another NetModem to create a dial-up router.

The dividing line between dial-up remote access and dial-up routing is being blurred by several multifunction products, such as the NetModem, the Dr. Bond-S, and the NetBlazer. These products handle both tasks, though usually one better than the other. They extend the network to the remote desktop or laptop PC via a modem and a telephone line, and they link two geographically separated LANs while keeping long-distance costs down. □

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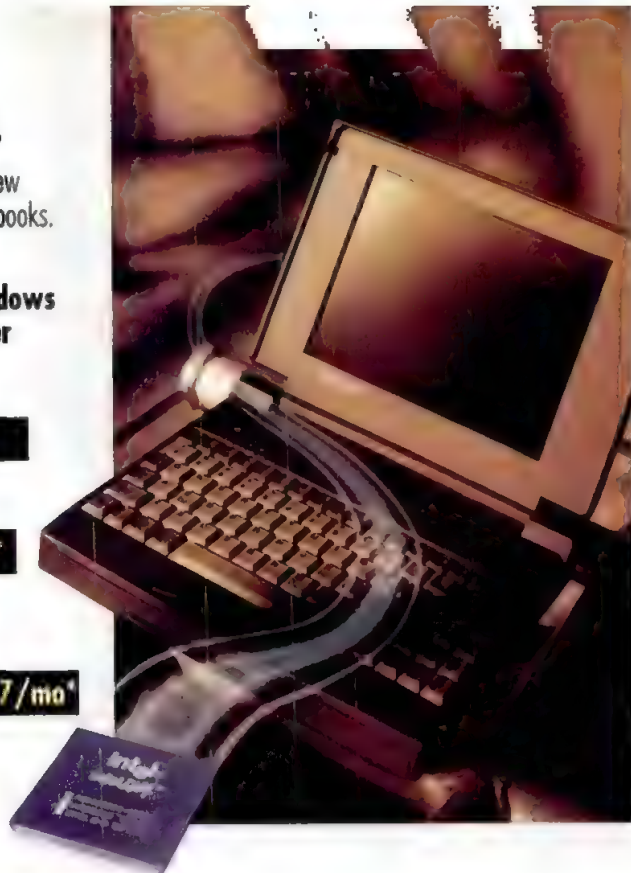
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Microcom Inc.

Microcom MBR/6003

BY JOHN GARRIS

The Microcom MBR/6003 router is fast; in fact, it was the fastest performer in this roundup. That was to be expected because the Microcom V.fast modem we tested it with can send and receive at 28.8 Kbps; all the other routers here support the V.32bis standard at 14.4 Kbps. However fast it was though, we did encounter a number of problems, including configuration difficulties, connections that were broken early, and poor management and security. In addition, the MBR/6003 did not have a 10BaseT connections or dial-on-demand when using IP.

The MBR/6003 requires a lot of space. It is basically a 386/25 computer, complete with monitor and keyboard. And you pay a premium price for all this hardware: The MBR/6003 with modem lists for \$3,198, which puts it at the high end for the group of routers reviewed here. It comes with a single Ethernet port that supports BNC and AUI connections. We had to provide our own external transceiver to make the 10BaseT connection. And because the unit came configured for BNC, we had to open the case and reset a jumper on the system board in order for the link to work.

Otherwise, configuring the router was fairly straightforward. Function keys allow you to maneuver through configuration screens, and selections are clearly displayed. Configuring dial-on-demand, however, was a chore. You have to create a text file containing detailed information, such as internal IPX network numbers

FACT FILE

Microcom MBR/6003

Microcom Inc., 500 River Ridge Dr.,
Norwood, MA 02062; 800-822-8224, 617-
551-1000; fax 617-551-1021

List Price: \$3,198 (modem included)

In short: The Microcom MBR/6003 was the fastest dial-up router we reviewed—thanks to its V.fast 28.8-Kbps modem. But its dial-on-demand capabilities were often difficult to use, and its management and security were weak. As more vendors offer faster modems with their dial-up router products, Microcom will need to refine its solution to stay competitive.



ON-READER SERVICE CARD

and node addresses, for each of the servers on all your remote networks. Other packages allow you to perform this kind of configuration from within the software, which would have made the process much easier.

We also encountered a problem during our IPX performance tests. When the unit was configured with a short inactivity time-out, the default 2 minutes or less, the link would be broken

even while we were still working. When we tried to reestablish the connection, the client system would hang, forcing us to reboot. A Microcom systems engineer suggested either increasing the time-out parameter or making changes to the remote server configuration. The documentation did not clearly alert us to this problem.

The router's management and security features were also deficient. The MBR/6003 is the only router here without a password authentication feature for a remote LAN dialing in. And although

you can display packet transmission statistics for each network card, you cannot generate a log file indicating link-time statistics. Also, there are no remote management capabilities. All router configurations must be performed on the local machine or via SNMP management.

To be sure, once we got the link up we were thoroughly impressed. Our performance tests showed the MBR/6003 to be at least twice as fast, on the average, as its competition on most of the unidirectional file-transfer tests. And it was the fastest performer on the bidirectional file-transfer tests as well (we do not report the bidirectional test results because they were similar to the unidirectional test results).

But speed isn't everything. Although the Microcom's V.fast DeskPorte modem made the router blazing fast, Microcom needs to address several shortcomings in both the software and hardware.

NEC America Inc.

Dr. BonD-S

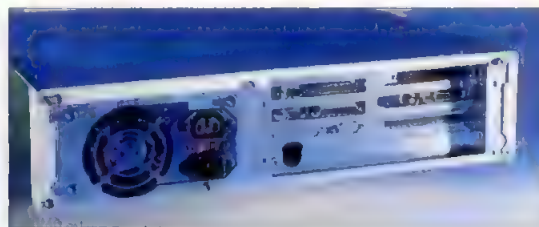
BY SALVATORE SALAMONE

With the Dr. BonD-S, NEC America has created a router that is relatively easy to set up and use, making it an excellent choice for the small-office administrator who might not have router expertise. It does so without compromising on features, and it provides configuration and management tools that both the WAN novice and the router expert can easily access and appreciate.

Installation of the Dr. BonD-S (short for *dial-up router bandwidth on demand*) is straightforward. We tested the unit with an internal modem; the router's Ethernet interface supports three media types: 10BaseT, 10Base2, and AUI. Once a cable is attached, the integrity of the connection can be verified either on the connected PC's screen or on the front-panel LCD. The LCD shows the status of the router, modem, and Ethernet port, as well as the number of connections and the total percentage of port utilization.

Regardless of your current setup, NEC simplifies configuration.

SUITABILITY TO TASK				
Microcom MBR/6003				
	POOR	FAIR	GOOD	EXCELLENT
Installation and configuration	●	●	○	○
File transfer	●	●	●	○
Link management	●	●	○	○
Network management	●	●	○	○



Because it's basically a full-fledged PC, the Microcom MBR/6003 has a large footprint (keyboard and monitor not shown).



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- **Storage:** 527MB Hard Disk, and one optional 170, 245, 340, 424 or 527MB Hard Disk
- **Memory:** 8MB RAM standard, upgradable to 64MB
- **Network Interface Card:** Ethernet or Token-Ring
- **Operating Environment:** IBM DOS with NetWare from IBM V.3.12 or IBM OS/2 LAN Server 3.0, Entry
- **Prices start at \$3,029*** (monitor not included)



PS/2 Server 85 466

- **CPU:** i486DX2/66MHz processor with 256KB L2 (write-back) cache, upgradable to Intel® Pentium® OverDrive™
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- **Memory:** 8MB RAM standard, upgradable to 232MB
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ValuePoint Mini-Tower 6387 Server

- i486™DX2/66MHz processor
- 527MB Hard Disk
- 8MB RAM
- IBM 14L8 14" Color Monitor (SVGA)
- Ethernet interface card
- IBM DOS and NetWare from IBM V.3.12 – 5 users

ValuePoint Si Clients (3)

- i486SX/25MHz processor
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- IBM 14L8 14" Color Monitor (SVGA)
- Ethernet interface card
- IBM DOS and NetWare from IBM Client
- **Price: \$8,359***



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ValuePoint client configuration options

- **CPU:** i486SX/25MHz to i486DX2/66MHz processor
- **Storage:** 120MB Hard Disk, up to 527MB
- **Memory:** 4MB RAM standard, upgradable to 64MB
- **Monitor:** IBM 14L8 14" Color Monitor (SVGA)
- **Network Interface Card:** Ethernet or Token-Ring
- **LAN Requester:** NetWare from IBM Client, or OS/2 LAN Server Requester
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NETWORKING

Dial-Up Routers



With a front-panel LCD and support for 10BaseT, 10Base2, and AUI connections, NEC's Dr. BonD-S covers all the bases.

For example, if the same port is used to connect to different sites, the characteristics of the physical interface—the modem, for one—are assigned only once, while the attributes—such as the phone number—are defined separately for each site. Once the physical connections to the network are made, you need only enter some basic information, including an IP address (which you can create if you don't plan to connect to the Internet), an IPX address (which the Dr. BonD-S will automatically discover from the network), and your IP and IPX routing choices.

Setting up the router to dial other locations requires only a few additional steps, and it ships with a collection of applications notes that give step-by-step configuration instructions for 16 different networking scenarios.

Management of the Dr. BonD-S can be performed locally by attaching a PC to the console port. It can also be managed remotely by telnetting to the router from any point on the network. The menu-driven

management interface, although not Windows-based, is clear, easy to use, and helpful. It includes menu items for built-in tools, such as ping, telnet, and a trace utility, and in many cases simply hitting the Enter key on a menu item will pop up a

list of choices. Contrast this to the majority of routers, which offer only command-line interfaces.

The Dr. BonD-S successfully completed our file transfers and data-

base query without hanging or unexpectedly dropping the line. In addition, its link management was excellent. The router automatically established a link when a packet was destined for a LAN at another site. And it automatically tore down the link after reaching a user-configured time limit for inactivity. Furthermore, the Dr. BonD-S offers a link-management tool to help control access and keep communications charges down by letting the administrator set limits on times of operation.

The Dr. BonD-S can be used in other networking configurations. And it can easily be expanded to accommodate

additional modem connections, which you can use as separate lines or inverse-multiplex together to provide a higher aggregate bandwidth link. It also can be used with digital dial-up services, such as ISDN or Switched 56, as well as leased lines. This is a router solution for users new to the field or for connectivity experts. The Dr. BonD-S has the power, approachability, and expandability for just about anyone.

Networks Northwest Inc.

BReeze 1000

BY J. C. LOVE

Networks Northwest's BReeze 1000 was, in fact, a breeze to set up, but it suffers from a variety of software problems. These include mishandled frames and difficulties in maintaining routing information. Its throughput is excellent, however, and Network Northwest Inc. (NNI) has a first-rate support system, which includes, among other things, instant software upgrades.

The BReeze ships with an internal V.32bis modem, and it automatically configures itself to your Ethernet connection type: 10BaseT, BNC, or AUI. The front-panel LCDs and controls eliminate the need to use a separate PC.

The BReeze's Easy Setup is a scripted configuration process. It presents you with a series of questions covering all the important options, including assignment of the telephone number of the target network, as well as IP routing, IPX routing, and bridging choices.

Configuring the BReeze for IP routing is about as basic as it can get. You enter the router's IP address, and the configuration routine is smart enough to pick an appropriate subnet mask for Internet addressing.

Although configuration for IPX routing

is simple, we found that the BReeze had serious difficulties maintaining IPX routing information. The unit establishes a connection across the serial link and builds a routing

table in the flash memory of each connected router. NetWare servers, however, typically send SAP packets advertising themselves once a minute. During our testing it appeared that the BReeze did not wait long enough to recognize all the NetWare servers on the network. To complicate things further, the NetWare server list wasn't always maintained in the routers during unconnected periods.

NNI says it addresses each of these

SUITABILITY TO TASK

Dr. BonD-S

	POOR	FAIR	GOOD	EXCELLENT
Installation and configuration	●	●	●	○
File transfer	●	●	●	○
Link management	●	●	●	●
Network management	●	●	●	●

SUITABILITY TO TASK

BReeze 1000

	POOR	FAIR	GOOD	EXCELLENT
Installation and configuration	●	●	●	○
File transfer	●	●	●	○
Link management	●	●	○	○
Network management	●	●	●	○

FACT FILE

Dr. BonD-S

NEC America Inc., 1525 Walnut Hill Ln., Irving, TX 75038; 214-518-5000, 800-222-4632; fax, 214-518-5572

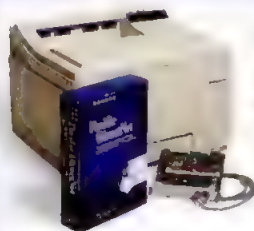
List price: \$3,095 (modem not included).

In short: An easy installation and setup, a good interface, and excellent link-management features make the Dr. BonD-S an excellent choice for novice or experienced administrators alike. The unit's LCD panel has helpful indicators, including percentage of port utilization. It performed well in our testing—with no hanging or unexpected dropping of the line.

ON READER SERVICE CARD

Pacific DirectNet.

It takes the pain out of sharing LaserJet printers on a network.



What a relief. At last there's a network print server card that eases the pain associated with managing networked printers.

It's called Pacific DirectNet. And painlessly, it connects HP® printers and plotters to virtually any Ethernet or Token Ring network, while simultaneously supporting Novell NetWare, UNIX TCP/IP and EtherTalk operating systems.



Pacific DirectNet is engineered to simplify the entire printer sharing process, from installation to everyday use. Software is included that allows automatic setup on Novell networks. And with support for LPR/LPD, FTP, TFTP, and RShell, it's easy to setup and connect printers to any UNIX network—Sun, HP, IBM, DEC, SCO, Solaris, and Interactive UNIX.

For network managers, upgrading to the latest network operating system or to new features of an existing one is surprisingly simple. Just slip a disk into a PC and update Pacific DirectNet's Flash memory. There's even an SNMP agent that allows network management software to recognize and manage printers just like it does other network devices.

With Pacific DirectNet, sharing a networked printer is no longer a headache for users either. Because with automatic switching between operating systems, they won't be troubled by frequent trips to the printer front panel to switch protocols.

Pacific DirectNet boards are available for HP LaserJet® III, IIID, IIISi, 4, 4M, 4Si, 4Si MX, PaintJet® XL300, DeskJet® 1200C, and DesignJet® printers and plotters. For more information, a dealer near you, or to order direct from Pacific Data Products, call us today at (619) 625-3676.



PACIFIC DATA
PRODUCTS

Performance Tests: Dial-Up Routers

Our testing bears out the idea that you'll want to use the fastest modem available in a dial-up routing situation. Analog telephone lines are widely available, but they are a slow means of data transfer overall.

What the Numbers Mean

LAN-to-LAN links over modems will be noticeably slower than Ethernet connections. For example, a 50KB file will take approximately 30 seconds to travel over a 14.4-Kbps modem link; the transfer will be virtually instantaneous over Ethernet.

The Microcom MBR/6003 router, as expected, scored the best consistently, by taking full advantage of its 28.8-Kbps V.fast modem (the fastest modem in the group). Its excellent test scores clearly make the case that faster modems bring about faster router performance.

In our testing, we found that for the noncompressible file and the slightly compressible WordPerfect and executable files, performance was fairly consistent across all products. We saw significant differences in router performance only with our highly compressible vector graphics file and the "combination file." In these tests, for both IPX and IP Livingston's PortMaster IRX and Network Northwest's Breeze 1000 proved the fastest of those routers with 14.4-Kbps modems. The Breeze uses a proprietary data-compression scheme on the router, which perhaps accounts for its excellent performance. The PortMaster does not perform IPX header compression; it offers only IP header compression. On the other hand, we tested the PortMaster with our standard AT&T ComSphere 3830 modem, a top scorer on the performance tests we ran for our June 29, 1993, modem roundup.

NETWARE BURST MODE

We used NetWare 3.12 for performance testing. One of the biggest changes in Version 3.12 that affects performance is the addition of *burst mode*. NetWare 3.11 required the NetWare client to acknowledge every packet it received from the server. This scheme works fine on LANs, because of the speed of the underlying Ethernet or Token-Ring topology. But this time-consuming acknowledgement process further degrades performance over a slow WAN communications link. NetWare 3.12's burst mode improves performance over WAN circuits by sending several packets before requiring an acknowledgment.

COMPRESSION SCHEMES

Both routers and modems can perform compression. Router compression works differently for different network protocols (IPX and IP) and across routers. Some routers use IP and IPX header compression, which takes advantage of the fact that network addresses are often repeated from packet to packet. Some of the routers also implement more elaborate schemes similar to V.42bis modem compression. And some routers offer no compression at all.

Analysis by Robert P. Lipschutz

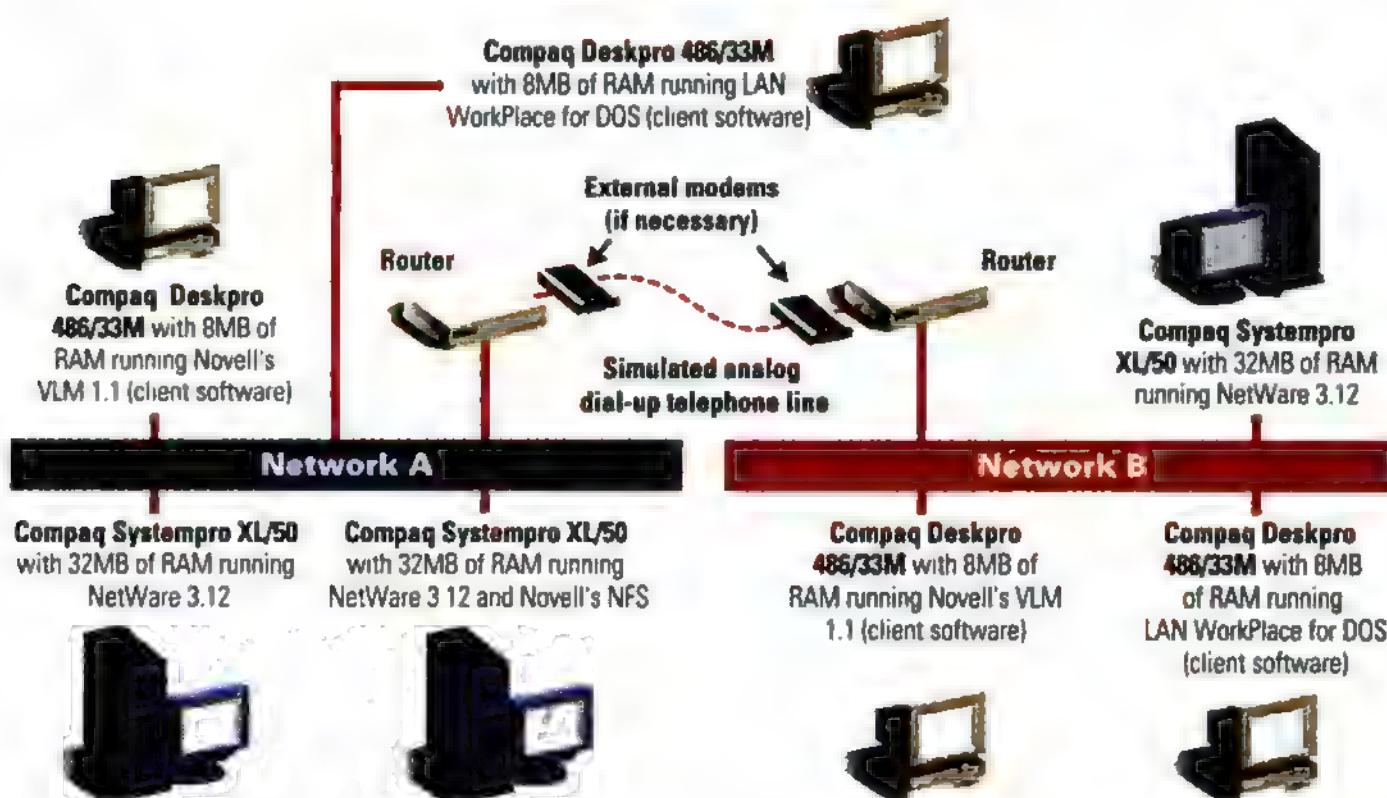
How We Tested

We created two networks for our dial-up router test-bed, and connected them over a simulated analog telephone line using the dial-up routers. We used Processing Telecom Technologies' (PTT) Model 5102 and 5151A equipment to simulate a public switched telephone network (PSTN) central office and analog local loop. The PTT equipment allowed us to impart delays and impairments, simulating a relatively good connection from San Francisco to Los Angeles (with a round-trip delay of 40 milliseconds), and enabling us to create repeatable testing conditions for all the routers.

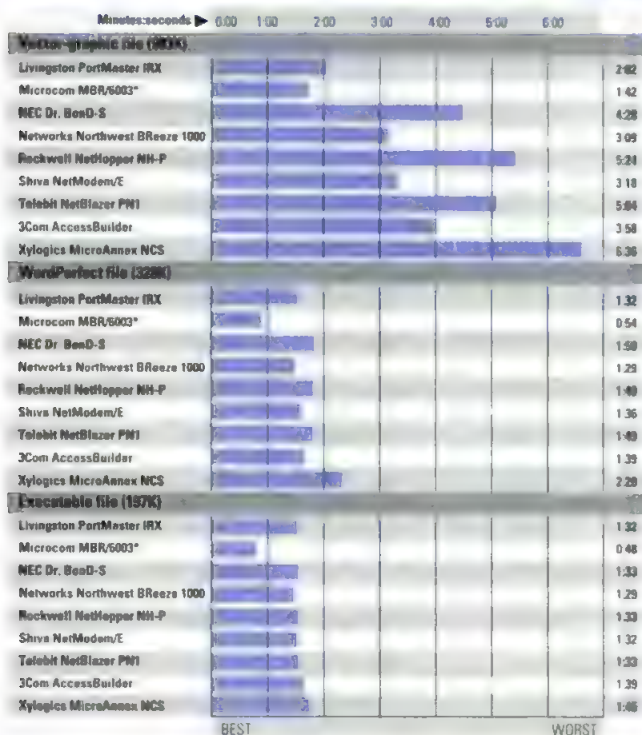
We ran two classes of unidirectional file transfers: **DOS-Based IPX File Transfers** and **FTP-Based IP File Transfers**. For the DOS-Based File Transfers, we sent data from the NetWare 3.12 server on Network A to the VLM NetWare client on Network B. For the FTP-Based File Transfers, we sent data from the

NetWare NFS server on Network A to the LAN WorkPlace for DOS client on Network B. We ran each test on five different files: a 983K **vector-graphic file** (highly compressible), a 328K **WordPerfect 6.0 file** (slightly compressible), a 197K **executable file** (slightly compressible), a 131K **noncompressible file** (similar to a PKZip-compressed file), and a 524K **combination file** (with both highly compressible and slightly compressible components). In addition, we measured the time required to transfer a set of **multiple files** over each of the two configurations by sending all five files at once. Using the V.42bis compression algorithm, we calculated the compressibility ratios to be from 1:1 to 7:1; each compressible file shrunk to approximately 131K. The reported results are the average timings for two trials. We also tested bidirectional file transfers, but we are not reporting the results here. The timings were proportional to those for unidirectional transfers.

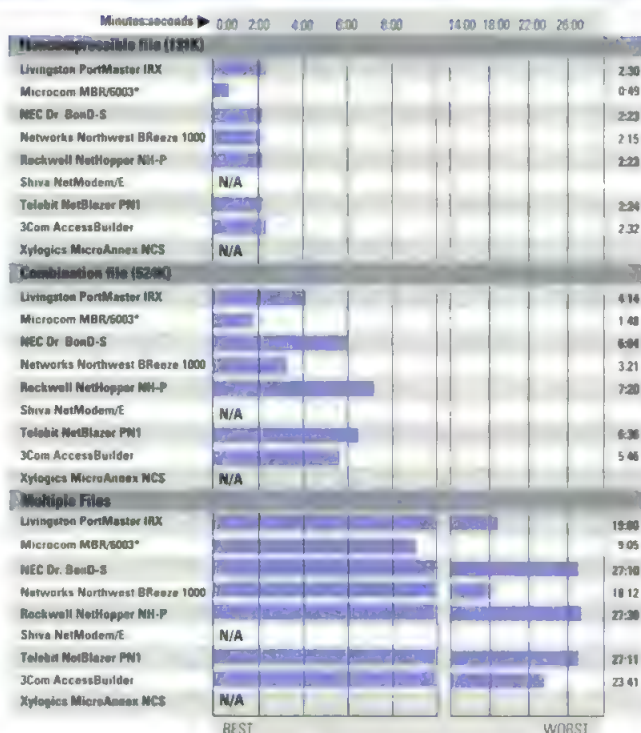
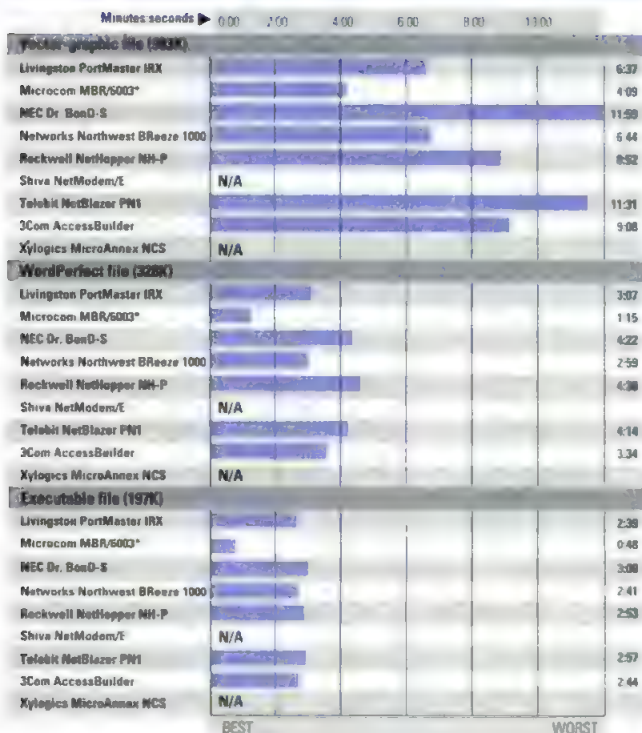
Our Test-Bed



DOS-BASED IPX FILE TRANSFERS



FTP-BASED IP FILE TRANSFERS



* We tested the MBR/6003 with a V fast modem, which gave it a much higher throughput than the other tested products.
N/A—Not applicable. The product does not support IP.

NETWORKING

Dial-Up Routers



The BReeze 1000's large front-panel LCD makes it unnecessary to use a separate terminal to monitor the connection.



problems in later releases of BReeze's software, and that brings us to one of the unit's greatest strengths: virtually instant software upgrades via an 800 number, with the code being downloaded into the BReeze's flash memory. Similarly, NNI technicians can dial into a BReeze to diagnose problems or upload new software. As with drivers, there is no formal update procedure; the code is continually tweaked by BReeze engineers, and new versions are made available to the public.

The integrated modem limits the BReeze to 14.4 Kbps, a problem not found in units with external modems. (Networks Northwest also makes the BReeze 1100, which uses an external modem.) However, NNI will offer a modem upgrade when the V.34 specification is approved. To its credit, the BReeze had one of the highest throughput rates of any unit tested with a V.32bis modem, thanks to its proprietary compression scheme.

The BReeze attempts to establish communications across the asynchronous link as soon as a packet needs to be routed. The unit established and negotiated connections acceptably, and it reliably broke the connection as soon as it reached

time-out problem while the router was performing heavy compression. Selecting Retry restarted the transfer in each case; this was more an annoyance than an obstacle.

The few problems we had with the BReeze are unfortunate in an otherwise well-designed, easy-to-use product. If later versions of the easily updated software work as promised, NNI's router is well worth a look.

*Rockwell International Corp.,
CMC Network Products*

NetHopper NH-P

BY SALVATORE SALAMONE

If installation ease is your primary concern, and you don't mind a command-line interface, NetHopper NH-P, from Rockwell International Corp.'s CMC Network Products, might do the trick. It was designed with speedy installation in mind, and it comes complete with an integrated, internal V.32bis/V.42bis modem and built-in Ethernet LAN ports that automatically sense the type of cable attached. The front-panel LEDs provide basic information about the state of the Ethernet connection and the modem, making it easy to get at least a quick overview of the system's status.

The NetHopper supports two types of Ethernet cabling, 10BaseT and AUI (it does not support a BNC connector), and it senses which type of cable is connected. Configuration is accomplished by simply attaching a PC to the unit's management console port. After you log on to the router, NetHopper's excellent quick configuration program asks for the router's IP address, IP subnet mask, IPX address,

a user-configured inactivity time limit. During performance testing we received several network-error messages caused, according to NNI, by a



FACT FILE

NetHopper NH-P

*Rockwell International Corp., CMC
Network Products, 7402 Hollister Ave.,
Santa Barbara, CA 93117; 800-262-8023,
805-968-4262; fax, 805-968-6478*

List price: \$1,695 (modem included)

In short: The NetHopper's easy installation and Ethernet auto-sensing make the job of routing over dial-up lines easier for a network manager who is new to this area. Overshadowing these benefits, however, is the product's cryptic, command-line interface, which makes it tough to access some of the features in this decidedly powerful product.

471 ON READER SERVICE CARD

and which Ethernet frame type to use.

Rockwell's NetHopper supports the four main Ethernet frame types: 802.2, 802.3, Ethernet II, and Ethernet SNAP (Subnetwork Area Protocol). This makes it easier for users running NetWare 3.12 (which uses the 802.2 frame type). But it is something that many of the routers in this roundup did not do. After you enter this information, the routing software automatically detects both IPX network numbers and network servers via the Service Advertising Protocol (SAP).

You choose the device on the other end of a link (in our case, another NetHopper) from a list of common devices, which includes routers and terminal servers. Rockwell provides built-in dialer scripts that issue the proper commands to connect to most other vendors' equipment, including common dial-up

routers such as Livingston Enterprise's PortMaster IRX and Telebit Corp.'s NetBlazer PN1. After choosing the device from the list, you answer a short list of questions about the particular log-on procedure of that server.

Once you answer those questions, the configuration information is saved to a disk in the router's floppy disk drive. Of course, if you have two NetHoppers, a similar configuration process must also be

FACT FILE

BReeze 1000

*Networks Northwest Inc., 3633 136th PL
SE, #100, Bellevue, WA 98006; 800-835-
9462, 206-641-8779; fax, 206-641-8909*

List price: \$2,950 (modem included)

In short: The BReeze 1000's easy setup, instant software upgrades, and high throughput recommend it as a well-designed solution in this market. These qualities are offset by a couple of problems, including mishandled frames, and unstable connections. All of these problems, however, are scheduled to be corrected by newer versions of its software, according to company officials. NNI offers first-rate support.

471 ON READER SERVICE CARD

SUITABILITY TO TASK

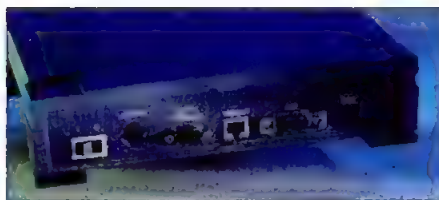
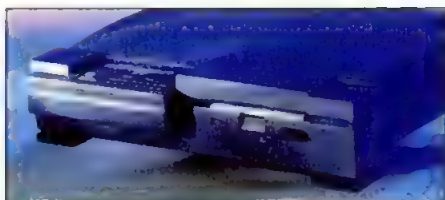
NetHopper NH-P

	POOR	FAIR	GOOD	EXCELLENT
Installation and configuration	●	●	●	●
File transfer	●	●	●	○
Link management	●	●	●	●
Network management	●	●	●	○

Microsoft At Work™ fax technology and super-fast networking that works with Novell® NetWare®, Windows NT™ and other standards, Windows for Workgroups 3.11 is an essential upgrade for any Windows 3.1 user. But there's only one way to experience this speed and power. Drive it.

Packed with new features like

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With clearly labeled connections and basic LEDs, the NetHopper NH/P is easy to set up and get running.

done for the router on the other end of the link.

The management software provides a number of useful utilities, such as ping and trace, for diagnosing problems. However, getting at those utilities often requires you to enter cryptic commands at a prompt. The saving grace of the management system is that you only have to enter one command, CONFIG SHOW, to see all configuration information, routing

addresses, and modem characteristics. Other routers, such as NetBlazer, offer the same information, but you need to enter separate commands to view the different parameters.

In performance testing, the NetHopper's file transfer results were good, but not exceptional. Its link management, on the other hand, was excellent; dial-on-demand worked without any difficulties, and the links were torn down after idle

periods (intervals when no data was passed between sites). And the routing software performed SAP spoofing to keep unnecessary broadcast packets from clogging the dial-up link.

Except for the command-line interface—which may intimidate users new to routers and wide-area connections—Rockwell's NetHopper NH-P is a solid solution for LAN-to-LAN connections.

Shiva Corp.

NetModem/E

BY TOM KREYCHE

Shiva Corp. helped write the book on remote access and modem pooling for the Macintosh. The NetModem/E has raised the company's profile in the PC market. For small offices, the NetModem/E, with

What's My Line?

By Gary Gunnerson

There are many ways to connect two remote LANs. Administrators often find that one of the most complex decisions they need to make is how to handle wide-area connections as the company's need for bandwidth increases. If you're using dial-up voice lines, you can add more of those. You can make provisions for Switched 56 or dedicated fractional T1 services. Or, if available locally, you can use basic-rate Integrated Services Digital Network (B-ISDN). (For a detailed description of these and some other services, including important differences between switched, packet, and dedicated services, see "Making the WAN Connection" in the March 16, 1993 issue of *PC Magazine*.)

Using a modem is easy but it's only inexpensive when the connection is used less than a few hours per day. It is also slow. Higher-speed digital lines reduce your connect time considerably but cost more initially. So when does it make sense to upgrade?

Most networking analysts agree that the time to move from analog

phone lines hovers at around 3 to 5 hours of operation per day—roughly 60 to 100 hours per month. But tying actual costs to these circuits can be an exercise in futility because rates and tariffs vary greatly. Certainly, though, your monthly telephone bills should surpass \$1,000 before switching is economical.

The decision is more complex than simply choosing the type of line you need or want. For Switched 56, frame relay, dedicated 56, and fractional T1 lines, you will need to purchase additional data service units (DSUs) and modules for your routers. DSU prices range from about \$500 for low-end 56-Kbps units to \$3,000 to \$6,000 for high-speed T-1 units.

You also need to arrange with your telephone company for high-speed local-access lines from each of your offices to the phone company's switching stations, a task that is not nearly as easy as having a new voice line installed. Neither is figuring the cost. You will incur a variety of charges, including installation fees and monthly line and possibly equipment-leasing

charges. They vary widely, so choosing the best media depends almost as much on geography as technology.

TOUGH NUMBERS FOR HARD DECISIONS

We gathered pricing information for typical circuits between Chicago, Washington, and Boston to arrive at some average monthly costs for dial-up telephone lines at 14.4 and 28.8 Kbps, Switched 56 service, dedicated 56-Kbps digital lines, and Integrated Services Digital Network (ISDN) service. For this scenario, we found the crossover point from analog telephone service to Switched 56 occurs at 60MB per day; at about that point you save enough money by using the 56-Kbps line to justify the extra cost.

Of these three, B-ISDN seems destined to win the hearts and pocketbooks of administrators at most sites with low-to mid-level usage. The line and installation charges of B-ISDN are about the same as a standard 56-Kbps connection, averaging about \$400 for installation and about \$40 per month, although these numbers are expected to drop.

Some of our reviewed routers offer B-ISDN options that can use two circuits to provide an aggregate throughput of 128 Kbps. This class of service looks too good to pass up over the short term,

its one modem, may be a fit.

The NetModem/E's versatility and relatively low cost make it a good choice for small offices that need dial-up routing, dial-in remote access, and dial-out modem pooling. However, its lack of dial-on-demand and automatic termination capabilities detract from its usefulness as a router as does its lack of support for IP.

In our tests, the NetModem/E proved reliable, turning in better-than-average performance. It is also easy to install, thanks to its compact one-port design and internal V.32bis modem, but it has only limited management capabilities.

That easy installation is a sure cure for modem phobia. After flipping back and forth between a couple of manuals, you connect a phone line and a network line, and you're ready to go. There's no fooling around with modem settings; the

default configuration works fine. The internal modem uses a Rockwell chip set for standard V.32bis support, and it has an added feature. It allows users to hear the connection process

on their PCs, although the router may be in another office. It's a useful feature if you don't mind the sound of a modem connection coming from your PC's speaker. There are, however, no visual

SUITABILITY TO TASK				
NetModem/E				
	POOR	FAIR	GOOD	EXCELLENT
Installation and configuration	●	●	○	○
File transfer	●	○	○	○
Link management	●	○	○	○
Network management	●	●	○	○

FACT FILE

NetModem/E

Shiva Corp., Northwest Park, 63 Third Ave., Burlington, MA 01803; 800-458-3550, 617-270-8400; fax, 617-270-8599

List price: \$1,699 (modem included)

In short: A reliable router with average performance, the NetModem/E has a simple installation routine but no graphical interface. Although security is good, the management software is somewhat weak. It does not offer dial-on-demand or automatic call termination—a frustrating and potentially costly omission. Despite some nice features including users' ability to hear the connection being made, this product is best suited only for small networks with patient administrators.

ON READER SERVICE CARD

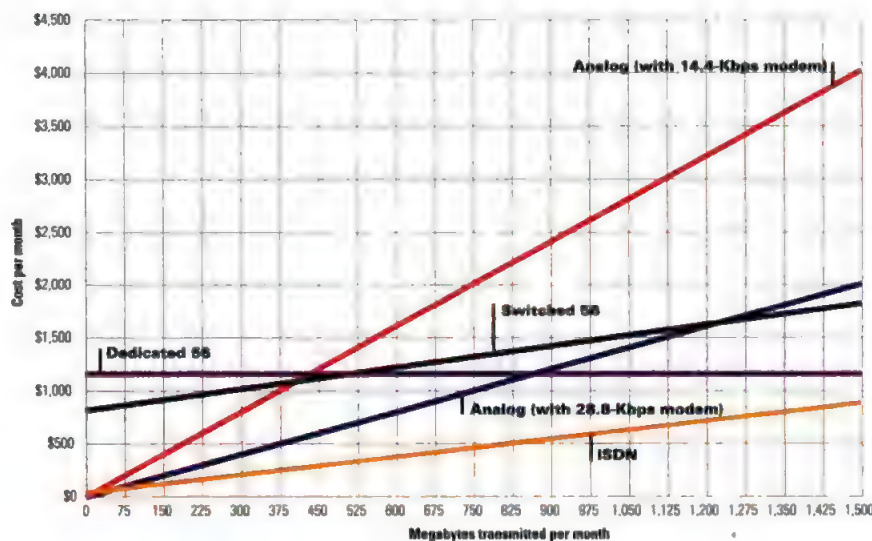
especially if your local access carriers provide ISDN links to your offices.

(One attribute of ISDN that deserves consideration over typical dial-up services is its virtually immediate call setup. A normal dial-up process takes time to open the line, wait for the carrier signal, dial the phone number, and handshake with the remote modem—adding more than a minute of nonproductive time. B-ISDN connects in milliseconds and helps return that lost setup time.)

There are other solutions to efficient data transmission, including frame-relay, SMDS, and T1. If your needs require multiple simultaneous connections, services based on packet-switching networks such as frame-relay or SMDS may make more sense. These services typically connect you to a communications "cloud" that provides connectivity with any other entity attached to the same cloud.

T1 lines offer throughput in the range of 1.544 Mbps, but is expensive and is often used for network backbone connection between locations.

Whatever kind of wide-area link you choose, you will always need to be prepared not only to upgrade your hardware, but to make the best connection. □



Choosing the right transmission line to connect your LANs depends on the amount of traffic you will be sending over the link in either direction (which could also be measured as the amount of time that link will stay open). This graph shows rough pricing estimates for five possibilities: analog (modem) connections at 14.4 Kbps and 28.8 Kbps, Switched 56 and dedicated 56 service, and ISDN connections. Pricing estimates are based on average transmission fees between Boston, Chicago, and Washington, D.C., with phone charges averaging about \$16 per hour. An ISDN connection is by far the least expensive option here, but ISDN is not yet widely available. Of the other choices, the slowest and most costly way of sending data is over analog (telephone) lines via 14.4-Kbps modems; you should switch to 28.8-Kbps modems as soon as you can. In this scenario, if you send more than 850MB per month long-distance via modem between only two sites (about 3 to 4 hours per day at 28.8 Kbps), a dedicated 56-Kbps connection is the most cost-effective solution. For transmitting data between multiple sites, consider using a Switched 56 connection, especially if you send more than 1,200MB per month long-distance (about 5 hours per day using a 28.8-Kbps modem). Remember that pricing in your area will probably be different. These numbers are meant only to give approximate cost relationships between the services.



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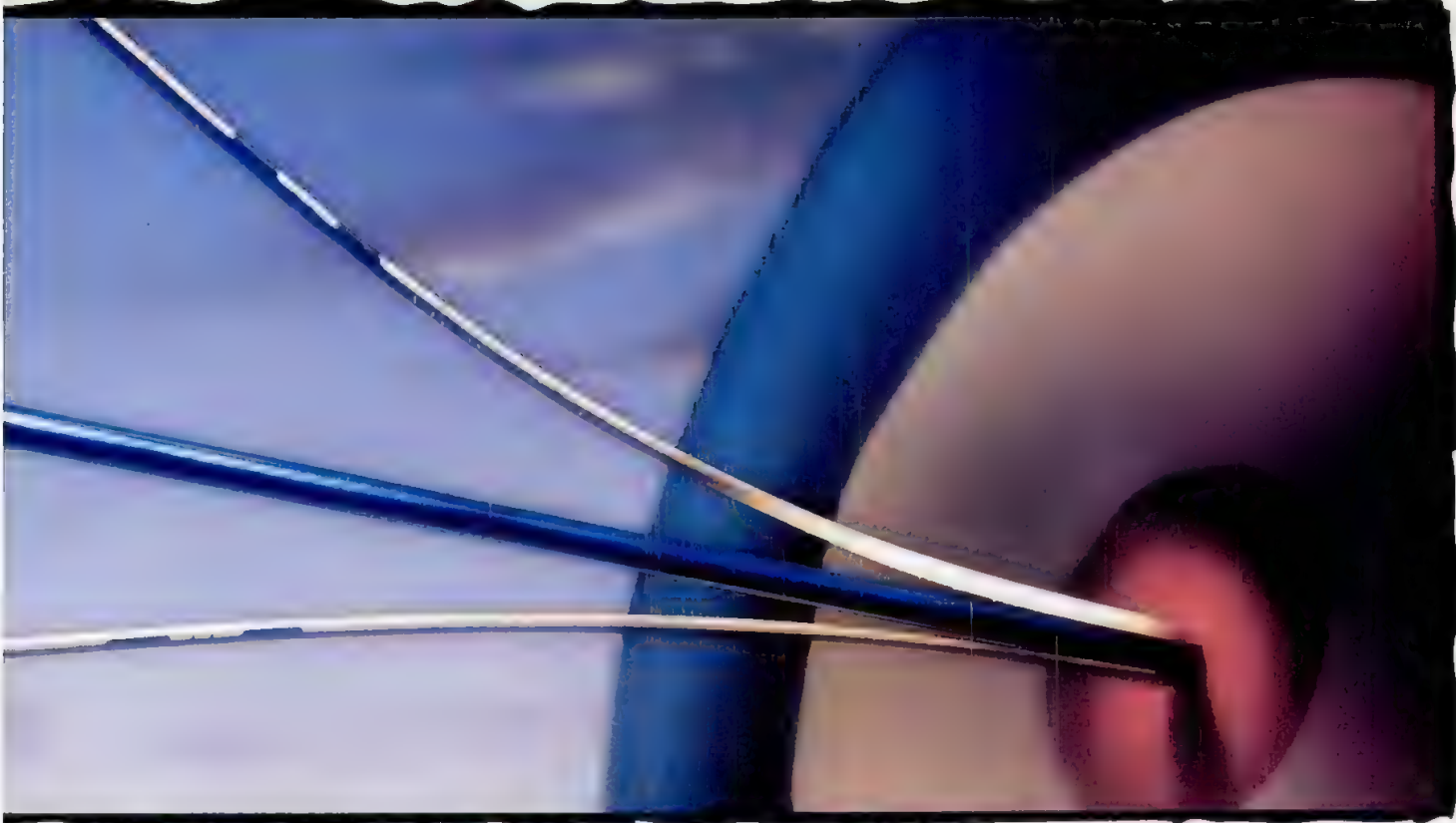
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CIRCLE 097 ON READER SERVICE CARD

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CIRCLE 118 ON READER SERVICE CARD

▪ Dial-Up Rocket Science

By J. C. Love

Connecting two LANs *should* be straightforward and pretty inexpensive, too.

After months or years of sending files via modem using communications packages or by overnight courier, you have finally decided to establish a wide area connection between your two office LANs. Maybe users at both sites need to connect over e-mail. You've explored the options, and you've decided you can use dial-up routers transmitting over standard telephone lines.

It shouldn't take a rocket scientist to implement that, right? Well, maybe not a rocket scientist, but many routers seem to require a router scientist.

First you'll need to decide which router to buy, and you'll need to purchase one for each site. You'll want them to be identical to minimize setup problems and to take advantage of unique features such as proprietary compression. Make sure they can handle the protocol you need to route, whether it's IPX (for NetWare LANs), IP (for Unix machines or Internet connections), AppleTalk (for Macs), or something else. And will they bridge any nonroutable protocols you need to support, such as NetBIOS?

When it's time to connect the routers, you'll have to decide where to put them. You'll need a phone line available at each location.

If your routers don't have integrated modems, you'll need to purchase them. Don't forget connecting cables with the right kinds of connectors. What kind of cabling does your network use in each location? Is it 10BaseT? 10Base2? 10Base5?

Remember also that you'll need power outlets for your equipment, preferably conditioned against power surges. And, if you don't install UPSs now, you will after the first electrical storm knocks out a router.

Part of the router's configuration

must be entered from its location. Even if your router has an automated process to build its routing tables, it needs to be told which protocols you want to route, details of its network's frame type, and the phone number of its target across the serial link. There might be more information required, especially if you are using external modems.

You will need someone at each site to configure each router. Perhaps you will need to travel to install it. Is travel in your budget? You might hire a consultant to handle the remote installation. Is that in your budget? Even if you use a consultant, you'd better plan on traveling. And you'll spend a fair amount of time on the telephone.

You're going to need to get involved in security issues, also. You don't want a bandit router dialing into one of your routers and becoming part of your network, so you will have to enable appropriate connection passwords. You may want to secure the packet transmissions themselves. And, although compression algorithms may make intelligent interception difficult, you may decide that using them is necessary. You may decide that you

need to encrypt your transmissions.

Each router will need to be managed directly. Some models include front-panel management. Others require that a console be connected to the router. For a console, you'll need to provide the terminal, its power source, and a data cable. And a caveat: If you need an alarm display, be prepared to buy a router that uses a full-time console or SNMP station.

Remote management—the ability to manage either the local router or its dial-up twin from a network workstation—comes in different flavors. You'll need TCP/IP software if telnet is your only choice for remote management. Routers from Shiva and Xylogics, which allow remote management using the more widely used IPX, might be more palatable in this case.

This whole affair doesn't just get more complicated than it should be: It gets expensive. The WAN business—even at this level—requires keeping your eyes open. Though dial-up routing may be the least costly approach to connecting your LANs, you'll be surprised at how much time and money you'll spend if you don't plan carefully. □

Lasting Impressions

What we wanted to see

- ▶ GUI-based, menu-driven, user-prompted configuration with easy-to-understand explanations for required information
- ▶ Automated discovery of Ethernet connector type, Ethernet frame type, IPX network addresses, and NetWare servers
- ▶ Documentation that anticipated questions, provided examples, and instructed on preconfiguring a router for a remote site
- ▶ Internal modems to ease hardware setup (it's a trade-off, though, because it makes upgrading to V.34 more difficult)
- ▶ Useful management information: link status by time period, user (MAC) address, and time of day

What we saw

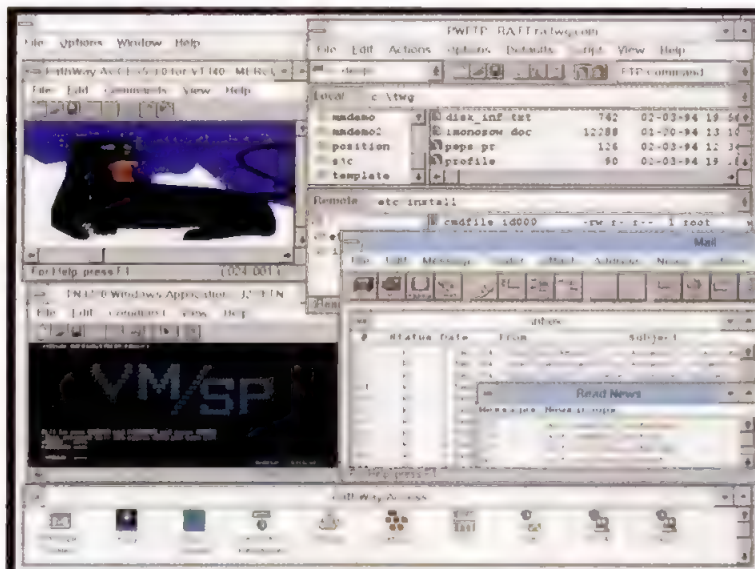
- ▶ Command-line interfaces that often required cryptic sequences of commands and frequent references to the documentation
- ▶ Routers that required the network administrator to enter much of the connection information manually
- ▶ Hard-to-navigate documentation, with few examples, no quick setups, and little information about managing the remote connection
- ▶ Seven of nine routers came with or accommodated internal modems (vendors know they need to deliver upgrade paths)
- ▶ Minimal and difficult-to-understand information that requires using cryptic commands to acquire.

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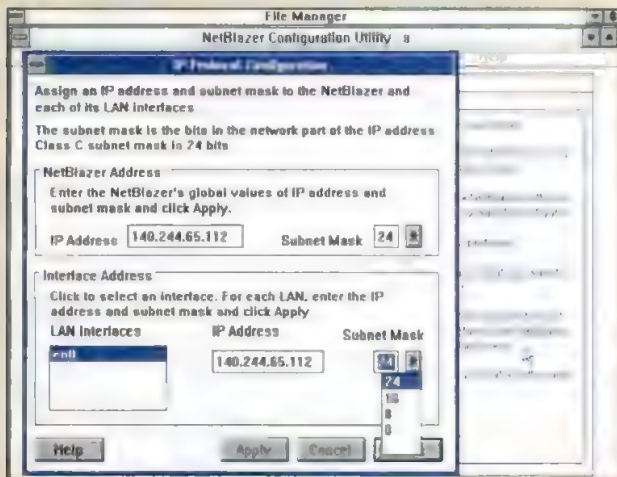
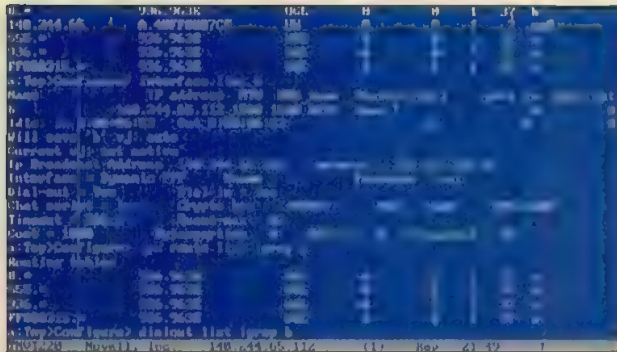
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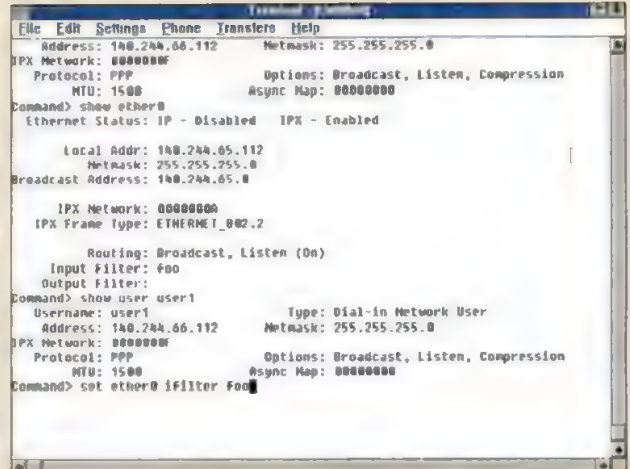
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CIRCLE 103 ON READER SERVICE CARD

Time for a Face-Lift

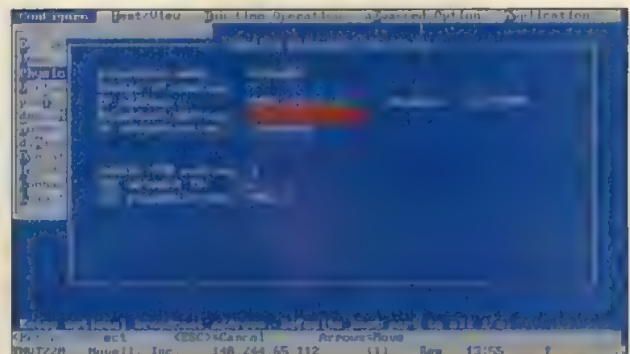
Interfaces were a mixed bag. For this class of router, they should be graphical and easy to use. But for the most part, users are forced to struggle with arcane command-line screens.



Telebit offers two ways to manage the NetBlazer: via a telnet session from a network PC (top), or with its Windows-based configuration software (bottom). The latter is a positive step for this class of router and makes the process easy even for routing novices.



Livingston's command-line interface leaves something to be desired; you need to learn a cryptic set of commands to use it.



The Dr. Bond-S's menued interface is easier to use than a command line; it's a good step, like Telebit's Windows utility.

cues to indicate the status.

The NetModem/E has two essential pieces of management software. The first, the Shiva Net Manager, allows the administrator to maintain router configurations, user lists, and passwords. It is especially useful if you are using other Shiva products, such as the Shiva LANRover. But its troubleshooting abilities and statistical information output are minimal. They only give you information on memory

usage, router configuration, and total uptime. Data logging is unavailable, but this is a moot point since there isn't much

Shiva really positions the NetModem/E as more of a remote access device, which explains the lack of more support for dial-up router functions.



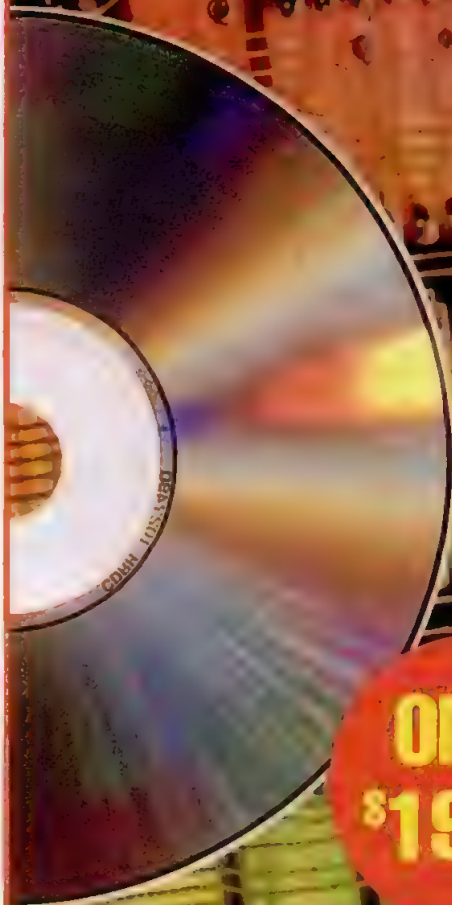
Although Shiva's NetModem/E has only three LEDs (to notify you of wiring problems), the router is a breeze to install.



to log. The software doesn't keep track of connection times, duration, or any of the statistics we found useful.

parameters, change them, save them to files, and load the new configurations to the router. It can also be used to download exe-

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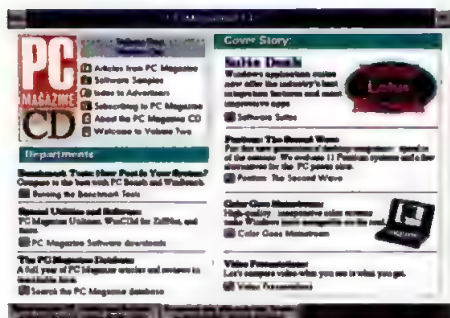
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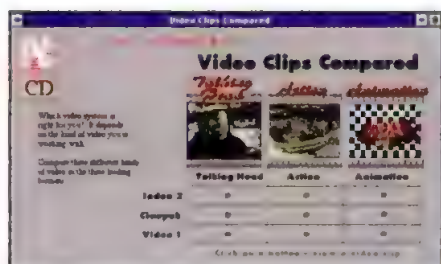
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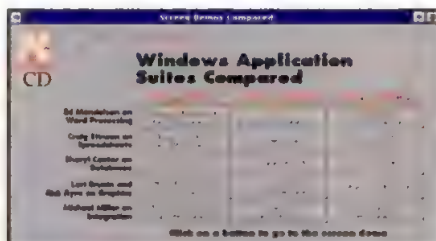
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NETWORKING
Dial-Up Routers

cutable software from Shiva's BBS to the unit's nonvolatile memory, making software upgrades easy. Security is robust: You can configure routers on both ends of the WAN circuit to accept only users with passwords. The program also allows administrators to terminate selected connections.

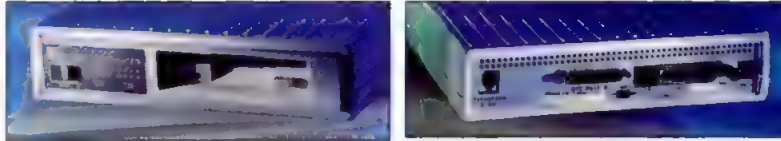
The other portion of the software handles connection management; it runs on the individual users' computers. Shiva provides two different programs. The principal application, SHIVANTN, is another nonintuitive DOS program. It allows connections to be configured, saved to files, initiated, and terminated. Unlike the Net Manager, there is no Windows version of SHIVANTN. The secondary application is a utility for initiating and terminating connections.

Versatile and limited at the same time, the NetModem/E seems best suited to a small office environment. Administrators who require support for IP routing will need to look elsewhere.

Telebit Corp.

NetBlazer PN1

BY SALVATORE SALAMONE
Telebit Corp.'s NetBlazer PN1 offers an extensive array of powerful diagnostic and management utilities, but it sacrifices ease of use along the way. It is thus only really suitable for administrators who are already familiar with router technology.



The NetBlazer PN1's eight LEDs help troubleshoot problems; it comes with support for 10BaseT (RJ-45), 10Base2 (BNC), and 10Base5 (AUI).

Newcomers to the field are likely to find the NetBlazer difficult to use, and they probably will not be able to take advantage of much of the product's power.

Installing the NetBlazer's hardware is easy. The unit comes with a built-in V.32bis/V.42bis modem and a single

Ethernet port, which supports three types of connections: 10BaseT, BNC, and AUI. The router also ships with an RS-232 cable and a null modem adapter. These allow a PC to be connected to the WAN port for configuration and management tasks.

Although installing the NetBlazer was quick, configuring it, unfortunately, was not. We went through nearly 20 command-line entries to set up the NetBlazer to route both IP and IPX, because they

need to be configured separately. The process is complicated, and configuring a second or third router is no easier than configuring the first, since the commands are not obvious even after going

through the entire process.

To Telebit's credit, this long process was well-documented. And the company has developed a Windows-based configuration/management program that holds promise for simplifying the procedure. Unfortunately, in our testing the

IT CAPTURED 67% OF THE ANTI-VIRUS MARKET BEFORE IT WAS EVEN IN A BOX.



Dial-Up Routers

Windows program could not establish a connection over the serial cable between a PC and the router's management console port. Once the router was configured, however, that program—running on a NetWare client attached to the same LAN segment as the NetBlazer—was used to confirm configuration settings.

FACT FILE

NetBlazer PN1

Telebit Corp., 1315 Chesapeake Terr., Sunnyvale, CA 94089; 800-835-3248, 408-734-4333; fax, 408-734-3333

List price: \$2,299 (modem included).

In short: A powerful product, from a traditional leader in this market, the NetBlazer has easy hardware installation but difficult configuration. It will appeal more to experienced LAN or WAN administrators. Newcomers may find its many features somewhat tough to implement. But its new Windows interface, although not elegant in this iteration, holds the promise for a robust product that will also be easy to use.

473 ON READER SERVICE CARD

Management of the NetBlazer can be performed through this same package from a client anywhere on the network, either through a telnet session or from a PC attached to the router's console port. The row of indicator lights on the front of the router are helpful in troubleshooting some problems.

The NetBlazer's link management features are excellent. Dial-on-demand worked well, and links were automatically terminated after data was passed between sites. Similar to other products, the NetBlazer performs IP and IPX header compression to save bandwidth. And, by default, the router does not send broadcast RIP and SAP packets across the network. Instead, the unit performs spoofing, only sending the changes when a router connection is up.

The NetBlazer's performance num-

SUITABILITY TO TASK				
NetBlazer PN1				
	POOR	FAIR	GOOD	EXCELLENT
Installation and configuration	●	○	○	○
File transfer	●	●	●	○
Link management	●	●	●	●
Network management	●	●	○	○

bers were good; it successfully completed all of our file transfers and database queries without difficulty. Although our testing focused on analog dial-up routing, the NetBlazer can also be connected to high-speed leased lines and digital dial-up lines through an external Switched 56 CSU/DSU (channel service unit/data service unit) or an ISDN (Integrated Services Digital Network) terminal adapter. In addition, the NetBlazer can also be configured to give individual users dial-up access to a network.

Its power and ease of expansion qualify the NetBlazer as a good choice over the long haul for connecting geographically dispersed sites with routers. But, despite easy hardware installation, its difficult configuration and interface mean it may not be the best first choice for a novice wide-area network manager.

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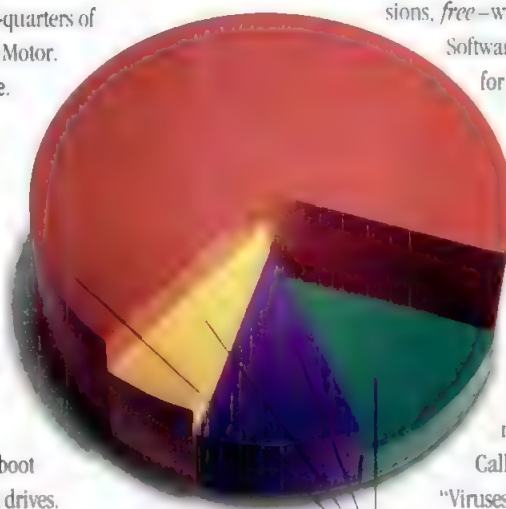
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3Com Corp.

AccessBuilder

BY TOM KREYCHE

Fledgling wide-area network administrators looking for easy LAN-to-LAN routing will appreciate 3Com Corp.'s AccessBuilder (formerly sold by Centrum Communications as the CentrumRemote 3000). It offers straightforward setup, automated operation, good security features, and—if that isn't enough—it comes with clearly written documentation and

command-line interface that will appeal only to true Unix aficionados.

The AccessBuilder has two rear slots for serial communications cards. Asynchronous cards are available in either 4- or 8-port versions, for a maximum of 16 asynchronous ports. The 4-port cards can handle higher throughput, which is useful if you are planning to use the fastest available modems. The avail-

SUITABILITY TO TASK

AccessBuilder

	POOR	FAIR	GOOD	EXCELLENT
Installation and configuration	●	●	●	○
File transfer	●	●	●	○
Link management	●	●	●	○
Network management	●	●	●	○

that is especially useful for installations that do not intend to implement SNMP management.

The interface's structure is divided into functional areas: administration, routing, bridging, port setup, and so on. Setting up the AccessBuilder requires a bit of jumping around the different configuration areas, but the task is not unduly difficult.

The AccessBuilder's modes of operation are configured on a port-by-port basis. When used with analog phone lines, on-demand operation is



The AccessBuilder, from 3Com, has a plentiful maximum of 16 asynchronous connections—or up to two 56-Kbps or T1 ports.

SNMP management. In addition, it supports a plentiful 16 communications ports. It does, however, suffer from a cryptic

able single-port synchronous cards take an entire slot, and are used for dedicated digital circuits such as a 56-Kbps or T1

■ It's a Management Issue

By J. C. Love

Expanding your LAN into a WAN will make managing it more complex but that management need not be overwhelming. In managing dial-up routers, much of your effort is required during installation and setup. After that, though, you will face local (direct) and remote management issues.

Direct management is accomplished either through a front-panel display and controls or through an attached console. With the front-panel approach, a small LCD typically displays alarms and the LCD or LED indicators provide status information. Front-panel controls are less widely used than a keyboard and screen, and LCD readouts are often abbreviated or require you to check documentation. Consoles are easier to work with, but you incur expense. Also, the console may have to be permanently connected in order for the router to display alarm conditions.

Most management activities should be able to be accomplished remotely. When you are managing from a network-connected workstation, you need to use a communications protocol supported by both the router and your network: IP, IPX, or even SNMP. Several routers require IP support. The router should support all protocols used by the network.

Few networks that use dial-up routers will use SNMP. Network-management packages that do (such as Hewlett-Packard's OpenView) are rather expensive for this slice of the WAN market, call for expertise that may not be available, and have traditionally required a Unix workstation (although this has been changing recently). Several dial-up routers support fairly complete implementations of SNMP, though, and as less expensive and easier-to-use SNMP-based tools become available, that can only be a plus.

The ability to set user-definable threshold alarms is an especially important capability for remote sites. Unfortunately, none of the dial-up routers we reviewed allow you to set remote alarms without a dedicated remote workstation—something you're not likely to spend a system on at this level. Built-in broadcast alarms or pager notification are certainly on our wish list.

Management statistics and logging capabilities vary widely. There is either too little data to manage configurations well or so much that its analysis requires expertise or frequent referral to documentation. One significant feature that should be developed is an ongoing automatic recommendation of configuration adjustments based on an evaluation of historical statistics.

The dial-up router market is still in its infancy, and we expect the network management features of these products to mature significantly. □

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• CHIP Magazine, Germany, March, 1994



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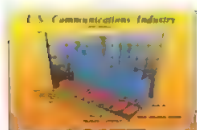
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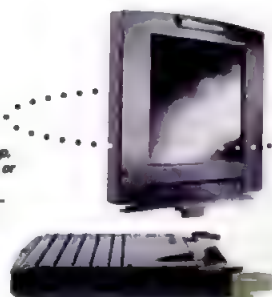
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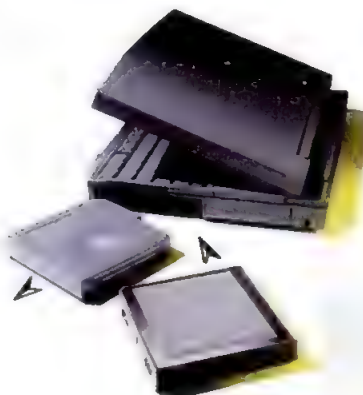
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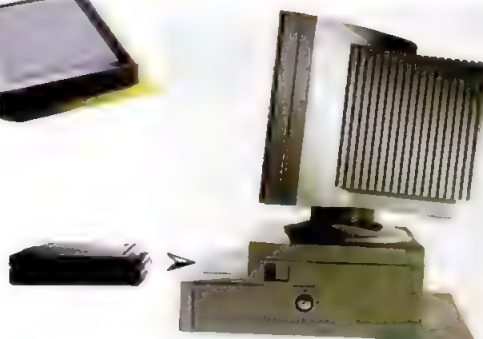
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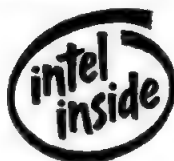


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■ Soft Sell

By Steve Rigney

Dial-up routers sit at one end of the WAN-product spectrum. If and when you decide to implement a high-speed link between sites, you'll have decisions to make, but you'll also have opportunities too.

Most of the vendors with products in this review carry an entire line of hardware routers that are designed for use in various situations. However, several software-only solutions for high-speed links are available from other vendors, such as Novell, which offers MPR+, and Newport Systems, which offers LAN2LAN MPR, for example.

Both of these packages provide power and flexibility in communications over expensive high-speed lines. Novell's MPR+, Version 2.11, costs \$1,495 for a single license (Novell, 800-638-9273). Newport Systems Solutions' LAN2LAN MPR sells for \$995 (Newport Systems Solutions, 800-368-6533.)

You can use either of these software products to link your networks over high-speed leased lines or frame-relay, X.25, or ISDN connections. Both support the Point-to-Point Protocol (PPP) and data compression, as well as IPX Routing Information Protocol/Service Advertising Protocol filtering to increase the performance of your WAN.

And although both packages sup-

port dial-up routing using synchronous connections such as Switched 56, you will have to install both a synchronous WAN card and a CSU/DSU in your router in order to use this feature. Using synchronous connections, you will not be able to use your favorite modem, though some synchronous modems are available. Some of the routers in the main review, such as NEC's Dr. BonD-S and 3Com's AccessBuilder can support both asynchronous and synchronous dial-up connections.

Novell's MPR+ is designed for permanent high-speed connections and does not offer dial-on-demand, bandwidth-on-demand, or any of the line-scheduling features that are found in most dial-up router solutions, and that many newcomers to the field find necessary. Newport Systems, however, is scheduled to release Call Connection Manager—which will add dial-on-demand, bandwidth-on-demand, and call-scheduling functionality to LAN2LAN MPR—by the second quarter.

Along with the many hardware-based routing solutions that you may have before you, also consider a software solution if and when you need to move on from a dial-up solution. They can reduce your initial cash outlay, while at the same time providing you with a powerful and robust connection between your sites. □

tions—typically used for leased circuits—or backups in case those circuits are lost. Remote access, a completely different mode of operation, is supported on separate ports while the server is performing LAN-to-LAN routing.

There is good support for IP, IPX, and AppleTalk; other protocols can be bridged. Configuring for IPX is simple, since the router can be set to learn the network number and Ethernet frame type automatically from the NetWare server. And 3Com's documentation eases the pain of IP routing configuration with step-by-step instructions and examples.

best, because phone charges will mount only when there is traffic for the remote end. We would prefer to see a configurable timer for shutting down idle circuits, but for AccessBuilder the time is fixed at 10 minutes (which is, at least, a sensible limit).

Whether you are using digital circuits or high-speed modems with analog lines, there will be times you need more bandwidth. In this case additional on-demand ports can take traffic overflow. For extra security, you can schedule connections to occur only at specific dates and times. You can also set up permanent connec-

► FACT FILE

AccessBuilder

3Com Corp., 5400 Bayfront Plaza, P.O. Box 58145, Santa Clara, CA 95052; 800-638-3266, 408-764-5000; fax, 408-764-5001

List Price: With four ports and Ethernet support, \$3,495 (modem not included); with 16 ports and Ethernet support, \$6,295 (modem not included).

In Short: Only a cryptic interface detracts from this otherwise excellent product. The AccessBuilder provides robust protocol support and flexible operation—plus a simple setup routine, good security, and excellent documentation. Its support for up to 16 asynchronous ports is a nice extra.

474 ON READER SERVICE CARD

And when we tested the server's performance with a popular V.32bis external modem, it turned in respectable numbers and provided reliable on-demand operation.

Two advanced features are useful for improving security and reducing unnecessary traffic. Filtering prevents specially defined packets from being forwarded from the Ethernet port. And you can enter static routes manually instead of letting the router learn them automatically; this lets you limit access to specific areas of the network.

For a powerful, if not always easy-to-use, LAN-to-LAN connectivity device, the AccessBuilder is a reliable, secure, well-implemented solution.

Xylogics Inc.

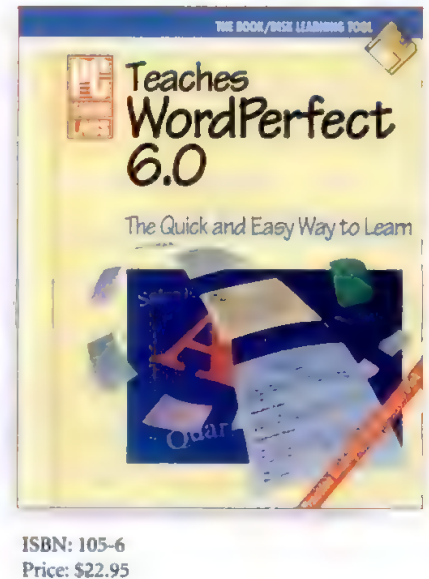
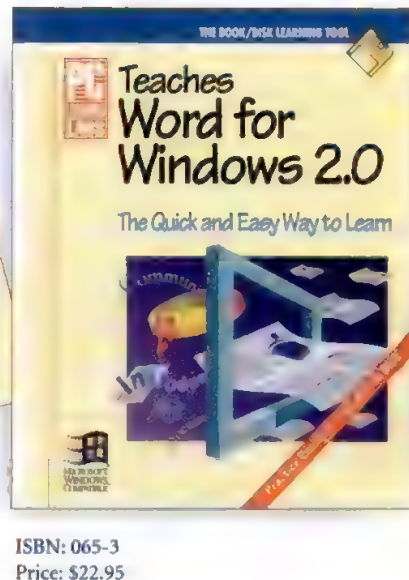
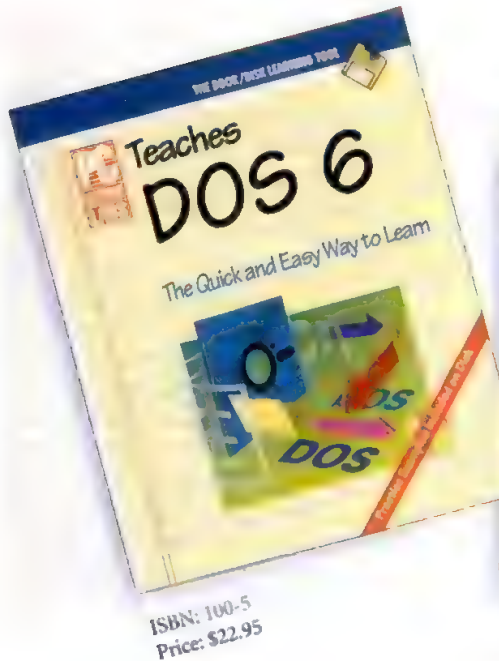
MicroAnnex NCS

BY JOHN GARRIS

The MicroAnnex NCS is an easy-to-use package that includes remote IPX routing, and dial-in and dial-out capabilities in one box. But it lacks dial-on-demand routing, which is an important feature for connecting over analog lines, and it was a slow performer—the slowest in the group. It took almost twice as long as the leaders did in some of our file transfer tests. That combination isn't good.

Xylogics' MicroAnnex NCS ships with a built-in V.32bis modem with V.42bis data compression. It also has a single serial port to allow an external modem to be

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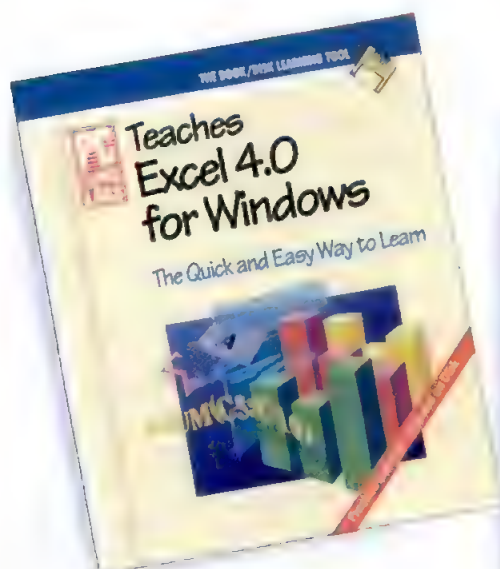
—Barry Mishkind, *Radio World*, reviewing *PC Learning Labs Teaches DOS*

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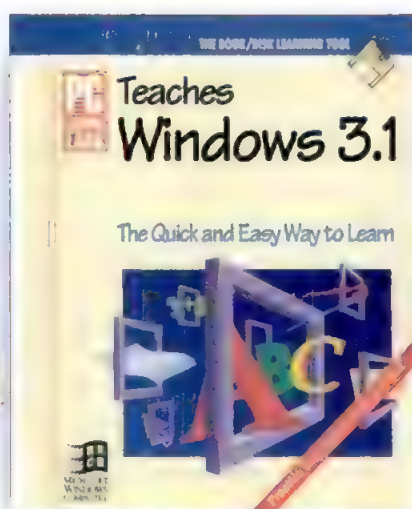
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—William J. Lynott, *Online Today*, reviewing *PC Learning Labs Teaches WordPerfect for Windows*

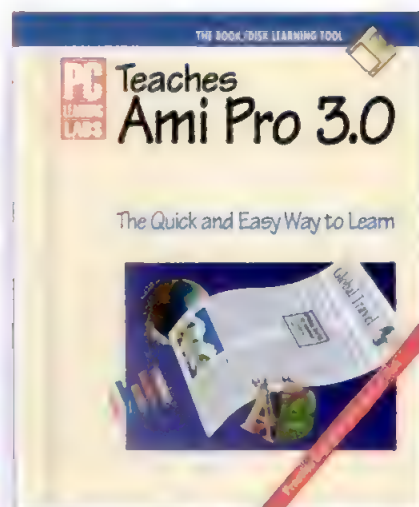
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—Hugh Anderson, *The Gazette*,
reviewing *PC Learning Labs Teaches DOS*



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NETWORKING *Dial-Up Routers*

► SUMMARY OF FEATURES

Dial-Up Routers



Products listed in alphabetical order

■ = YES □ = NO

	Livingston PortMaster IRX	Microcom MBR/6003	NEC Dr. Bond-S	Networks Northwest Breeze 1000	Rockwell NetHopper NH-P	Shiva NetModem/E	Telebit NetBlazer PN1
List price (tested configuration)	\$2,395	\$3,198	\$3,095	\$2,950	\$1,695	\$1,699	\$2,299
Modem included	□	■	□	■	■	■	■
Ports							
Number of synchronous ports on tested unit	1	1	None	None	None	None	None
Number of asynchronous ports on tested unit	1	None	4	1	1	1	2
Maximum number of synchronous ports	4	2	6	None	None	None	None
Maximum number of asynchronous ports	1	None	36	1	1	1	2
Maximum number of Ethernet ports	1	1	3	1	1	1	1
Network Protocol Support							
IPX	■	■	■	■	■	■	■
IP	■	■	■	■	■	□	■
AppleTalk	□	□	■	□	□	■	■
802.1-compliant bridging	□	■	□	■	□	□	□
NetBIOS	□	■ (via bridging)	■	■ (via bridging)	□	■	□
Frame Types							
Ethernet II (TCP/IP default)	■	■	■	■	■	■	■
Ethernet 802.2 (NetWare 3.12 default)	■	□	□	□	■	■	■
Ethernet 802.3 (NetWare 3.11 default)	■	■	■	■	■	■	■
Ethernet SNAP (AppleTalk default)	□	■	■	■	■	■	■
IPX WAN protocols	PPP, SLIP	HDLC	PPP, IPXWAN	PPP	PPP	PPP	PPP, IPXWAN
IP WAN protocols	PPP, SLIP	HDLC	PPP, CSLIP, SLIP	PPP	PPP	N/A ①	PPP, CSLIP, SLIP
Hardware							
Processor	AMD Am386DX/40	Intel 386SX/25	Intel 386DX/25	Fujitsu 950/20, Motorola 68340/16	Intel 386SX/25	Motorola 68000/16	Intel 386SX/20
RAM	1MB	2MB	4MB	512K	1MB	512K	4MB
Status lights	■	□	■	■	■	■	■
Maximum asynchronous port speed	115.0 Kbps	N/A	115.0 Kbps	57.6 Kbps	57.6 Kbps	115.0 Kbps	115.0 Kbps
Communications							
Dials on demand	■	■ (via IPX only)	■	■	■	□	■
Supports V.25bis dialing	■	■	■	■	■	□	■
Can tear down circuit automatically	■	■	■	■	■	□	■
Remote-node support	■	□	■	■	□	■	■
Modem pooling	□	□	■	□	□	■	■
Compression Schemes							
IPX header	□	□	■	□	■	■	■
IP header	■	□	■	■	■	N/A ①	■
V.42bis on modem	N/A ②	□	N/A ②	■	■	■	■
Other data-compression schemes	None	LZS	None	Proprietary	None	None	None
Management and Security							
Windows install program	□	□	□	□	□	■	■
Quick configuration option	■	□	□	■	■	□	■
Console configuration option	■	□	■	□	■	□	■
Telnet configuration option	■	□	■	■	■	□	■
SNMP agent	■	■	■	■	■	■	■
Reports circuit-up time statistics	■	□	■	□	■	■	■
By user, MAC address, or network address	■	N/A ②	■	N/A ②	■	□	■
By routable network protocol	■	N/A ②	■	N/A ②	■	N/A ③	■
Alarms	□	■	■	■	■	□	■
Password protection	■	□	■	■	■	■	■
Dial-back security	■	□	■	□	□	□	■
Software							
Boot area	Flash memory	Floppy disk	Hard disk	Flash memory	Hard disk	Flash memory	Hard disk
Software upgrade method	Via floppy disk, Internet	Via floppy disk, download	Via floppy disk, Internet, download	Via download	Via floppy disk, Internet, download	Via floppy disk	Via floppy disk, Internet, download
Customer Support							
Toll-free technical support	■	□	■	■	■	Optional	■
Telephone support hours (eastern time)	11:00-9:00 M-F	8:00-7:00 M-F	8:00-8:00 M-F	11:00-8:00 M-F	11:00-8:00 M-F	8:00-8:00 M-F	9:00-9:00 M-F
888	□	■	■	■	□	■	■
Duration of free support	Unlimited	Unlimited	1 year	1 year	1 year	Unlimited	1 year

N/A ①—Not applicable: The product does not support IP

N/A ②—Not applicable: The product does not have this feature

N/A ③—Not applicable: The product supports only one routable network

NETWORKING

Dial-Up Routers

3Com AccessBuilder	Xylogics MicroAnnex NCS
\$3,495	\$1,295
☐	☒
None	None
4	2
2	None
16	2
1	1
☒	☒
☒	☐
☒	☐
☒	☐
☒	☒
PPP	Proprietary
PPP, SLIP	N/A ①
Intel 960/20	Hitachi HD69180/9
5MB	512K
☒	☒
57.6 Kbps	57.6 Kbps
☒	☐
☒	☐
☒	☒
☐	☒
☐	N/A ②
Proprietary	None
☐	☐
☐	☒
☒	☐
☐	☐
☒	☐
☒	☐
☒	N/A ③
☒	☒
☒	☒
☐	☒
Flash memory	Flash memory
Via floppy disk,	Via floppy disk
Internet, download	
☒	☒
9:00-9:00 M-F	8:00-8:00 M-F
1 year	Unlimited

attached as well, providing a nice upgrade path to V.34 modems when they become available. The router has one Ethernet interface, which can be 10BaseT, BNC, or AUI. A Token-Ring version of the MicroAnnex is also available, as well as a configuration without an internal modem.

Installing the MicroAnnex is a fairly simple task. You configure the router using a DOS application that resides on a network file server. After you enter a few simple configuration parameters, the application automatically downloads your configuration into the router's flash memory.

The management program, furthermore, is simple and straightforward. Its menu-driven structure and dialog boxes make this product easier to configure than most other packages here. Many of the routers in this roundup require a telnet or PC console session and force you to use cryptic Unix-like commands.

The MicroAnnex's poor performance might be attributable to its compression scheme. We also found some bugs in the software. At times it would indicate that a configured modem was still unconfigured, and on more than one occasion our DOS client system hung when we tried to exit the program.

In addition, unlike traditional dial-on-demand routers, the MicroAnnex does not connect to the remote LAN seamlessly. Like Shiva's NetModem/E, it requires an individual user to use a DOS utility in order to call the remote router manually. Furthermore, there is no automated tear-down process, so the link remains up until that same user chooses—and remembers—to bring it down. Remote servers are only visible when the link is actually up, and while it is up all users have full access to the resources on the remote LAN. When



Besides its built-in V.32bis modem, the MicroAnnex NCS supports an external modem as well, plus RJ-45, BNC, or AUI ports.

FACT FILE

MicroAnnex NCS

Xylogics Inc., 53 Third Ave., Burlington, MA 01803; 800-225-3317, 617-272-8140; fax, 617-273-5392

List price: \$995 (modem not included); \$1,295 (modem included); with Token-Ring support, \$1,795 (modem included)

In short: If you need only infrequent connections between sites on your wide area network, try the MicroAnnex. It's inexpensive and easy to use. Otherwise, this router's poor performance and lack of on-demand dialing make it a less-than-ideal solution.

475 ON READER SERVICE CARD

a user brings the link down, however, all users automatically lose their connection to remote servers—without notification.

Basic management and security features in the MicroAnnex are easy to configure. You can set up user accounts to allow dial-out (for example, to an on-line service), dial-in, and LAN-to-LAN connections—nice flexibility features.

Simple password and callback mechanisms are provided for greater network security. Unfortunately, the software does not provide any configuration options to filter NetWare broadcast packets, and Novell's 802.2 Ethernet frame type is not supported, a problem if you are running NetWare 3.12.

Xylogics' MicroAnnex NCS provides an inexpensive, easy way to connect two NetWare networks together. But if you are only concerned with speed or seamless, multiuser LAN-to-LAN connectivity, you will probably do better considering another product—one that offers, among other things, dial-on-demand capabilities. □





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APPLICATIONS DEVELOPMENT

Building a Better App, SQL Style

No time, no money, and a need for an application? Here are three places to begin.

By Gabrielle Gagnon

Teamwork allows average people to produce above-average results. This applies of course, to applications development. Teams of developers must be able to collaborate effectively if they are going to produce applications that economically and quickly increase the scale of PC systems. In order to accomplish this task, many developers turn to client/server computing.

Not surprisingly, we've seen a recent boom in client/server development tools. The question we address here is to what degree these solutions meet the needs of developers—low cost, high performance, and a high level of collaboration. These

tools have much in common; perhaps the most obvious is their use of SQL (structured query language). SQL, which has emerged as the industry standard for manipulating databases, is at the forefront. No large-scale development tool would be complete without it.

Hence our review of three packages that purport to be large-scale SQL development tools: Gupta's SQLWindows, Version 4.1, Corporate Edition; KnowledgeWare's ObjectView, Version 3.0; and Powersoft's PowerBuilder, Version 3.0.

They are new releases of three of the products previously discussed by *PC Magazine* in a comprehensive review of SQL front ends ("SQL: Putting Up a Good Front," November 9, 1993). Not all of the packages in that SQL front-end review were appropriate for enterprise development, which is the focus of this review. In fact, many of them lacked team development tools. The filter for the earlier review was simply that the products be front-end development packages. It didn't focus on the needs of enterprise developers, as we do here. Also, an Editors' Choice was not awarded in that review; several of the major packages were in beta or were just about to release a new version.

All three packages are professional development kits for building client applications that run under Windows. They

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provide access to a system via SQL, exploit rapid applications development techniques for creating working systems quickly, and provide resources for development teams. To gauge how well these products meet the needs of enterprise developers, we examine them in five areas that can make or break a development project: rapid applications development, connectivity, querying and reporting, programming tools, and team development.



EDITORS' CHOICE

• SQLWindows, Version 4.1, Corporate Edition

Version 4.1 of SQLWindows leads Version 3.0 of Powersoft's PowerBuilder by a hair's breadth. The difference lies primarily in Gupta's full-featured team development toolset, TeamWindows, and its no-nonsense approach to object-oriented programming.

Its ability to build class libraries and its support for multiple inheritance give SQLWindows' Application Language a distinct advantage over PowerBuilder's scripting language. Its version control and use of repositories for code and documentation as well as for objects make it a better all-around workgroup tool.

PowerBuilder isn't far behind though, with Version 3.0a, which was released during the writing of this article. Version 3.0a offers a number of enhancements, including all back-

end interfaces free of charge.

KnowledgeWare's ObjectView, Version 3.0, falls short in some categories but is unique in its broad back-end support, especially with nonrelational and transaction-processing systems. ObjectView also offers good integration with other data modeling and version control systems.

The competition between these three rivals remains fierce. One thing is certain: The real winners in this constant game of catch-up are the developers.

RAPID APPLICATIONS DEVELOPMENT

Evaluating each product's aptitude for rapid applications development allowed us to cut to the core of what these packages do best: let you develop applications quickly. Because they allow you to reuse prewritten, reliable code, they minimize development time.

Several techniques facilitate rapid applications development, such as automatic code generation and visual programming, but one of the most important is object-oriented programming (OOP). OOP utilizes encapsulated modules of programming code and data called *objects*. Objects can be abstracted into object types, called *classes*, which can create new objects or be modified to create new subclasses.

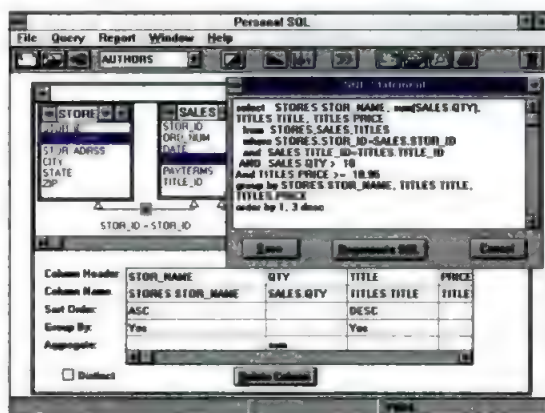
Since subclasses inherit the characteristics of their parent classes, programmers need only supply code for what has changed. For example, if you already have a class for printing a document in a particular format and you want to print documents in a different format, all you have to do is create a subclass and change the format. The rest of the processing, such as initializing the printer and selecting fonts, is handled through inheritance.

Inheritance is one of the major advantages of OOP since it effectively eliminates redundant programming. OOP dramatically reduces development time by allowing programmers to reuse encapsulated objects in many applications and adapt them with a minimum of programming effort. And because OOP allows you to recycle reliable code, it facilitates building

systems with fewer bugs, too. OOP departs radically from traditional programming styles, however, and some of its more esoteric theories are difficult to grasp.

ment, we evaluated the specific techniques they used to produce applications quickly, particularly the degree to which they implemented object-oriented programming. We also evaluated how those techniques affected productivity.

In our testing, we found PowerBuilder an outstanding tool for rapid applications development. Its slick suite of Painters—graphical tools that aid applications development—has been honed to afford a level of productivity and polish that is difficult to beat. This quasi-object-oriented package provides many of the advantages of OOP, such as encapsulation of objects, without any of the headaches. If you are already familiar with database concepts, you will be able to learn PowerBuilder quickly since all of its tools will have a familiar look and feel. PowerBuilder combines visual programming techniques with an intuitive point-and-click approach. It supplies all of the standard Windows objects and several custom objects that are so powerful that you can build a complete sophisticated application in less than an hour.



MATCHMAKER: ObjectView's Personal SQL identifies common fields to facilitate joining related tables.

The ideal programming environment would call for a hybrid of OOP and traditional programming, and all three of these products provide such an environment. When we rated the packages in this roundup for rapid applications develop-

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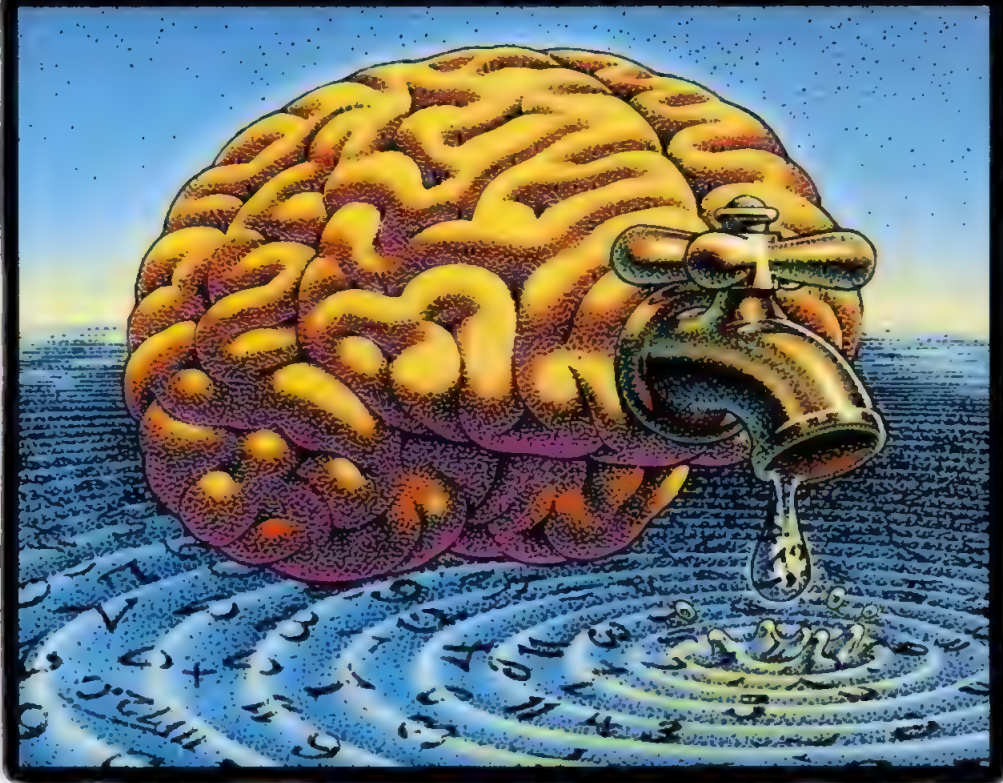
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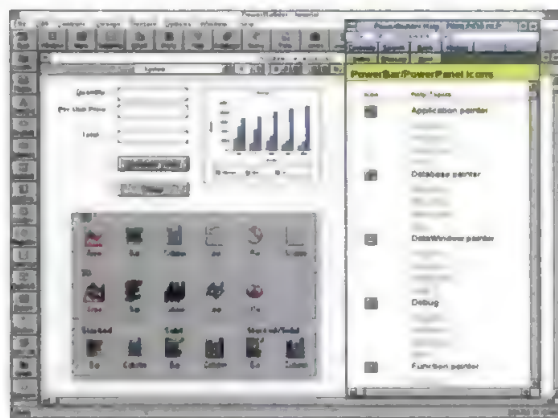
One of these custom objects, the DataWindow, is a data-aware control of tremendous flexibility. DataWindows are associated with a data source, such as a query, and can change presentation styles such as tables or graphs without any coding. You can even change the presentation styles of individual columns within a data source. For example, you might choose to display a name and address in data entry fields and a person's gender in a radio button format. Because the DataWindow is so powerful, it is the main vehicle for producing PowerBuilder reports.

Once your PowerBuilder application is finished, you don't need to throw it away and start over from scratch with the next one. Each application object and its extended attributes are automatically cataloged in a library database for easy access and reuse later.

SQLWindows is also no slouch when it comes to helping you produce applications. SQLWindows takes a more traditional approach than PowerBuilder in its use of class libraries, yet it shields the developer from much of the complexity of OOP. Although it is not as simple to work with, SQLWindows features many of the same capabilities for producing sophisticated interfaces quickly, and it adds some programmer productivity aids to boot. The Outline Options window, for example, provides a context-sensitive dictionary of all the functions and constants available to the operation you're coding. When you double-click on a function, SQLWindows will insert the code for that function into your application and highlight any replaceable parameters.

ObjectView, on the other hand, is a relative newcomer to visual programming and object orientation. The visual ObjectView Editor, which paints screens, is new to this release and is still, to a large extent, parameter-driven. Its design does not enhance programmer productivity nearly as much as the design of PowerBuilder or SQLWindows. If you want to change the size of a window, you have to call up a dialog box and type in

the coordinates instead of dragging the outline with a mouse. In its favor, ObjectView is the only tool in this roundup that offers automatic code generation. Once you create the data model for your appli-



APPS IN A SNAP: Window Painter, the elegant help system in PowerBuilder, facilitates rapid application development.

cation and select the columns you wish to see, the Logical Data Modeler design tool will automatically generate source code for a default form based on the model. You can modify this source code as you like.

Suitability to Task: Enterprise Front-End Development Tools

These development toolkits are Windows-based SQL packages designed for building industrial-strength client applications. We assessed each product in five areas of concern to enterprise development.

Rapid development The ability to expand prototypes into working systems is often crucial. We assessed how well these products enable rapid application development through the use of visual-programming tools, code generation, reusable modules, and integration with data modeling tools. We also evaluated the quality of user interface-design tools and the breadth of standard interface components.

Connectivity Since an enterprise's data is often distributed throughout the organization, connectivity between a front end and a variety of back-end

CONNECTIVITY

Front-end systems need a back-end data source to connect to, and in an enterprise that uses IBM mainframes, Unix database servers, and flat-file databases on a LAN, connectivity is vital. While the relational databases we reviewed all speak SQL, they don't all speak the same dialect, and large enterprises often have nonrelational databases on mainframes that don't speak SQL at all. One solution to the SQL dialect problem is to use middleware as a translator. Middleware such as Microsoft's Open Database Connectivity (ODBC) and Information Builders' EDA/SQL acts as an intermediary between the client and the database server, providing a single application program interface (API) for front-end applications while handling most of the back-end communications transparently.

When evaluating connectivity, we checked the number and variety of back ends a package can communicate with, including its support for middleware products, and we considered the robustness of its communications protocols.

All of these packages are compatible

systems is essential. We scored each package on its ability to operate with other systems by looking at the number of protocols and back ends it supports and its ability to handle multiple APIs.

Querying and reporting Stored information must be retrieved and organized. We evaluated the extent of each package's SQL support and the range and quality of its analysis and report-writing tools.

Programming tools To deliver bulletproof mission-critical systems, programmers need powerful tools that facilitate development. We

looked for a strong, extensible programming language, an assortment of debugging and diagnostic tools, comprehensive help, and a developer-friendly environment.

Team development Enterprise development often requires that developers work in tandem. We rated each package by the quality of

its resources—especially repositories, version control, and security—and its ability to operate with other workgroup products.

SUITABILITY TO TASK

Rapid development	POOR
Connectivity	FAIR
Querying and reporting	GOOD
Programming tools	EXCELLENT
Team development	EXCELLENT

with numerous SQL databases, but ObjectView provides the broadest back-end support. In addition to supporting direct APIs, ObjectView supports numerous middleware products, including ODBC and Netwise's TransAccess. TransAccess permits high-integrity interaction between ObjectView and a Customer Information Control System and an information management system transaction-processing systems on IBM mainframes—something that is lacking in the other packages reviewed here.

There was little difference between the other two in terms of connectivity. PowerBuilder had a slight edge over SQLWindows: Unlike SQLWindows, it supports Microsoft's ODBC, which provides SQL access to several PC database and spreadsheet products. PowerBuilder's DataWindow also supports HLLAPI (High-Level-Language Application Program Interface), a mainframe terminal-emulation protocol, and SQLWindows does not. ObjectView supports both ODBC and HLLAPI.

QUERYING AND REPORTING

Connectivity won't get you far if you can't select the data you need from the database you're using and present it in meaningful ways. So we evaluated the querying and reporting capabilities of each of these packages. We looked at how easy it was to formulate complex queries and how many kinds of reports and reporting styles were supported. Some types of reports can be problematic. For example, crosstabbed reports (which correlate data in a two-dimensional matrix) and two-pass reports (which require you to compute large sums and other aggregate values before running the report) need a higher level of sophistication in a report writer than straight columnar reports. Since users often want to cus-

tomize their own ad hoc queries and reports, we gave bonus points to packages that included tools for this purpose.

All of the packages have visual tools for generating SQL queries and for producing professional-looking business reports and charts, although PowerBuilder charges extra for them. (SQLWindows and ObjectView bundle their end user querying and reporting tools

with their packages.)

PowerBuilder offers optional rotatable 3-D graphs. Its versatile DataWindow object is particularly useful for executive information system reporting. SQLWindows' Quest is a design tool that can produce sophisticated queries and reports with a minimum of effort, and power users will like its ability to work with variables for picture objects.

In Version 3.0, ObjectView gained Personal SQL, an end-user query generator and report-writing tool. Within Personal SQL is a visual tool for selecting and joining data that is similar to the Logical Data Modeler but much simpler. Although ObjectView has some nice features, it is often inconsistent and departs from standard Windows conventions, which makes it more difficult to use. Personal SQL includes a graphical report writer, a great improvement from the text-oriented report writer supplied in ObjectView 2.1, but it still lags well behind SQLWindows and PowerBuilder's report-writing capabilities. While it can produce tabular as well as columnar reports with embedded graphics, you would have to write code to produce crosstabbed or two-pass reports. Crosstabbed reports correlate information in a two-dimensional matrix. Two-pass reports calculate totals (or other aggregates like minimum values) and supply them as inputs to the report. In other words, the aggregates have to be computed before the report is printed.

PROGRAMMING TOOLS

Developers of large-scale systems need a powerful, extensible programming language that can be adapted to meet specific business requirements, and they need robust debugging facilities to isolate and correct any problems. They also need

SUMMARY OF FEATURES

Enterprise Front-End Development Tools

Products listed in alphabetical order

■ = YES □ = NO

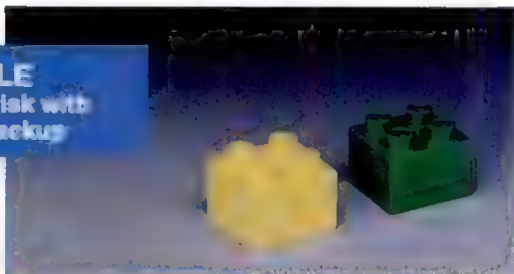
	ObjectView	PowerBuilder	SQLWindows
List price	\$2,899	\$3,595	\$3,795
Interface Design			
Visual programming tools	■	■	■
Automatic code generation	■	□	□
Comprehensive standard controls	■	■	■
Data-aware controls	■	■	■
User-definable controls	■	■	■
Back-End Host Support			
DBMS APIs	Informix, Quadbase, Teradata	ALLBASE/SQL, DB2, DB2/Z, Informix, WATCOM SQL, XDB	ALLBASE/SQL, Cincom Supra, DB2, DB2/Z, Informix, Ingres, SQL/400*
Mainframe interfaces	CICS, HLLAPI, IMS (via TransAccess Gateway)	HLLAPI	None
Oracle	■	■	■
SQLBase	□	■	■
SQL middleware	DB2/Integrator, EDA/SQL, MDI, ODBC, Q+E	DDCS/Z, MDI, NetGateway, ODBC	EDA/SQL, MDI, Q+E
SQL Server/Sybase System 10	■ □	■ ■	■ ■
Language Features			
Dynamic/static/embedded SQL support	■ ■ □	■ ■ ■	■ ■ ■
Standard-language DLL support	C, C++	C, C++, COBOL	C, C++, COBOL
Extensible classes/User-definable functions	□ ■	■ ■	■ ■
Query and Reporting Tools			
Query generator	■	■	■
Columnar/form-based report writers	■ ■	■ ■	■ ■
Chart and graph generator	■	■	■
Programming Tools			
Source editor/Browser/Inspector	■ ■ ■	■ ■ ■	■ ■ ■
Debugger/Source tracer/Error trapper	■ ■ □	■ ■ ■	■ ■ ■
Syntax checker	■	■	■
Interactive testing facility	■	■	■
Other	DBA, documentation	Code/object, DBA, object cross-reference, object search	Code assistant, collapsible code outliner, DBA
Workgroup Support			
Version control	■	□	■
Shareable modules	■	■	■
Code/object libraries	■	■	■
Interfaces to other workgroup tools	ADW, PVCS	PVCS	None

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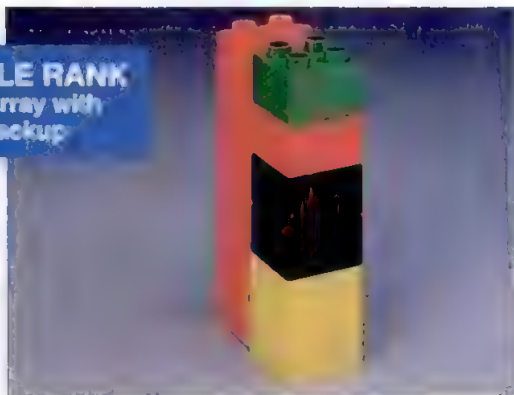
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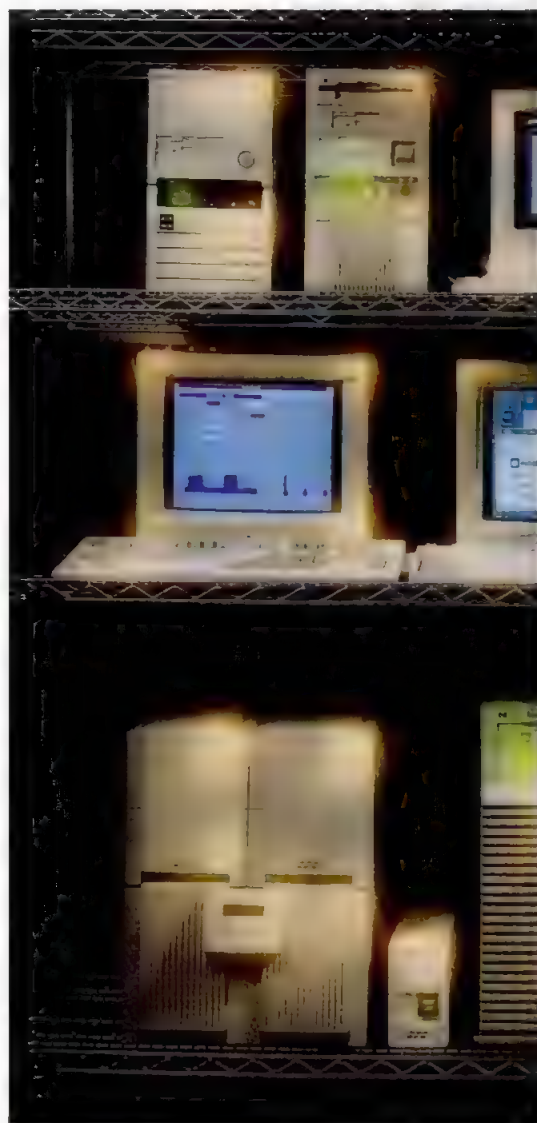
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tools to make them more productive: a way to organize and track code efficiently and a developer-friendly environment that speeds up their tasks. Each of these packages includes a standard suite of programming tools such as a scripting language, editor, compiler, debugger, browsers, and an interactive testing program, along with some extra features that distinguish them from the other two.

SQLWindows' Outliner is a navigation tool that depicts an entire application in a collapsible tree structure. This versatile tool lets you display the tree in multiple windows, each with a different view of the application, enabling developers to navigate easily to any module in the system and to drill down to any level of detail they choose. With Version 3.0, ObjectView added a similar tool as well as a new impact analysis utility called Sherlock's View. Sherlock's View catalogs screen components and identifies all the screens that make use of a particular object. ObjectView's Logical Data Modeler presents a graphical representa-

► FACT FILE

PowerBuilder, Version 3.0

List price: \$3,595 **In short:** A powerhouse of development tools, PowerBuilder is especially adept at producing polished, full-featured applications in virtually no time. Its suite of Painters provides a high level of productivity and polish. PowerBuilder also provides its users with a level of familiarity, adding to its ease of use. For large-scale development projects, it falls a little short in team development support, but its strengths far outweigh its weaknesses.

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Programming tools	★★★★★
Team development	★★★

tion of a database and the relationships between its tables including cardinality (one-to-one or one-to-many). You can join tables by dragging a foreign key to its related table and dropping it on the related column. An arrow linking the two

objects is automatically displayed. You can annotate these arrows with brief text clarifying the relationship. The Logical Data Modeler will also work with data models prepared by KnowledgeWare's Application Developers Workbench (ADW), a much more sophisticated analysis and modeling package.

PowerBuilder provides a similar graphical representation of data models in its Application Painter, and its Database Painter has a number of productivity aids to speed up data definition.

One of the most important programming tools included with any development package is the programming language. All of the products provide a proprietary event-driven scripting language that is extensible through function calls to dynamic link libraries, and except for ObjectView, these new releases support .VBX extensions too.

SQLWindows Application Language (SAL) is the only one that supports object-oriented classes. Since SQLWindows developers can form a subclass from any

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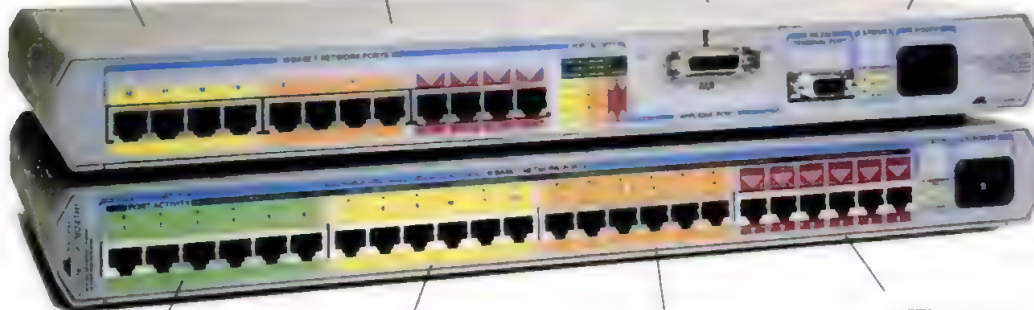
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object—including standard Windows controls—in SAL, they don't need to write C++ programs, for example, from scratch to provide the same functionality. SAL's class implementation supports multiple inheritance, which gives an object the ability to derive characteristics from more than one parent class. PowerBuilder also provides a limited form of single inheritance for Windows objects (that is, a child window derives its variables and methods from a single parent window). ObjectView does not provide support for encapsulation or inheritance, but KnowledgeWare has said it will in the future.

TEAM DEVELOPMENT

Working on a large-scale development project almost always means working on a programming team, and a package built for large-scale development has to provide for that. At the least, a package needs a centralized repository of reusable objects and preferably of other system resources as well. It should allow developers quick access to shareable modules whenever

► FACT FILE

ObjectView, Version 3.0, Developer Edition

List price: \$2,899 (includes Personal SQL); Workgroup Enablement, \$199; Workgroup Library, \$699; Personal SQL (standalone), \$499; standard database drivers, \$699; extended database drivers, \$299; Quadbase Database Engine, \$499. **In short:** Superb connectivity, integration with KnowledgeWare's data modeling and analysis packages, and comprehensive team-development tools make ObjectView a good choice for large-scale development projects, but its lack of object orientation and inconsistencies in design keep it from being as useful as it could be.

KnowledgeWare
Inc., 3340 Peachtree
Rd. NE, #1100,
Atlanta, GA 30326;
404-231-8575
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development

Connectivity

Querying and
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Programming
tools

Team
development

they need them but also protect work in progress from unauthorized or mistaken entry. If the company maintains multiple versions of application modules, the pack-

age should support some form of version control—either its own or another system's—and if the company uses other workgroup packages, it should be able to work with them. Project management tools are also important, especially for large-scale projects. Team managers want to track modules through the stages of development, testing and acceptance into production, and they want to control when a module is promoted to the next level.

SQLWindows and ObjectView are the strongest products in this category. SQLWindows Corporate Edition includes a package called Team Windows, a set of tools with extensive features for managing and facilitating large-scale development projects. Team Windows has comprehensive repositories for source code, documentation, and other application resources, as well as for standard data dictionaries and object libraries. These facilities are shareable and can be checked in or out by authorized users. User profiles determine access, and security levels range from project administra-

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- QUARTER-INCH MINICARTRIDGE**: A drive unit is shown in the foreground on the left, below the 8mm drive.
- 4MM DRIVES**: A drive unit is shown in the foreground on the left, below the quarter-inch drive.
- MEDIA/SUPPLIES**: A collection of tape cartridges is shown in the foreground, centered.
- LIBRARIES**: A large, white, floor-standing tape library is shown on the right side of the image.

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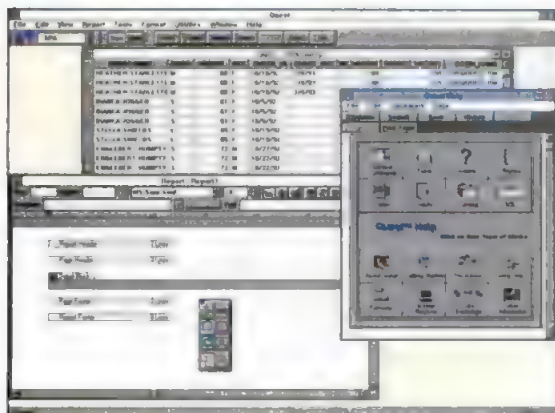
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INTUITIVE: SQL Windows' Quest is a push-button utility for producing sophisticated reports without coding.

tors and project managers to developers and testers. Team Windows also includes version control and promotion-level security. Each module can be assigned a promotion level with conditions attached to its promotion to the next level. For example, a sign-off option ensures that test libraries are formally approved before they can be moved into production.

Another strong feature of Team Windows is the inclusion of template libraries. Templates are screen definitions that can be used to generate other screen definitions. Since templates are screen classes, any changes to the original template immediately ripple down to derived screens through inheritance. This feature

drastically reduces system maintenance and allows developers to give a consistent look and feel.

ObjectView also has strong team development resources. Its Workgroup Library includes shareable object and file libraries, which can be divided into application domains or subsystems. This allows teams to share resources within a workgroup as well as access centralized dictionaries. The Workgroup Library also provides promotion-level security and flexible version control. Its versioning hierarchy allows for multiple releases as well as multiple versions within a release. ObjectView also provides support for Intersolv's popular PVCS version control system.

Except for PVCS support and centralized libraries for shareable objects, PowerBuilder does not provide much in the way of team development tools. The Version 3.0a upgrade, released after our tests were completed, adds an Application Framework library, which should enhance its workgroup offerings.

All three packages have the brains and the brawn to deliver smart-looking, robust applications. The one you choose may largely be a matter of taste. If producing systems quickly is your main concern, you can't go wrong with PowerBuilder or SQLWindows. For sheer ease-of-use and versatility, PowerBuilder is hard to beat. Its suite of Painters can help you create a masterpiece in a matter of hours. SQLWindows offers the extensibility of object-oriented classes libraries and a cadre of programming tools that serve the developer on every scale—from the single-programmer prototype to the hundred-member downsizing team. ObjectView too has plentiful resources for development teams and levels of connectivity that are scarcely dreamt of in the DOS world. Whatever your corporate development challenges are, these packages are ready to take them on.

STRONG AND GOOD-LOOKING, TOO

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GABRIELLE GAGNON is a frequent contributor to *PC Magazine* and the director of new product development for Weseley Software Development Corp.

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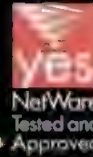
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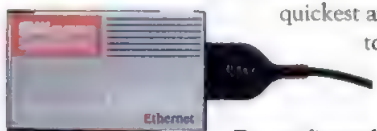
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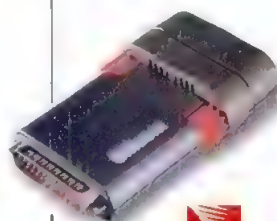
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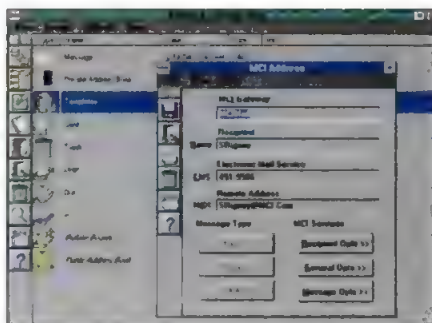
Artisoft Answers Peer-to-Peer Challengers

BY STEVE RIGNEY

Artisoft's LANtastic was once comfortably ahead of the peer-to-peer LAN pack. But in our latest roundup of peer-to-peer LANs ("Peer Pressure," April 26, 1994), it lagged behind two other packages in features: Microsoft's Windows for Workgroups (WfWG), Version 3.11, and Performance Technology's POWERlan, Version 3.0 (Editors' Choice). Though LANtastic may never regain its former status as the undisputed market leader, the latest release—Version 6.0—brings it back into contention for the top spot.

New features include the ability to attach clients to multiple network environments, an enhanced e-mail package, a new scheduling utility, and a performance-enhancing burst-mode file-transfer method. LANtastic's management has also been improved with support for central monitoring of remote servers. Essentially, LANtastic 6.0 is an improved NOS in all respects.

LANtastic, WfWG, and POWERlan all support connectivity to multiple NOSes, but LANtastic offers the most efficient way of achieving it. Version 6.0 clients can connect to NetWare servers (2.x, 3.x, and 4.x) using Novell's NetWare Core Protocol and IPX. Connections to WfWG and Windows NT servers are also supported by way of the Server Message Block (SMB) and NetBEUI protocols. The key here is that LANtastic supports all of these connections through a single universal software redirector, which



NEW LOOK: LANtastic's e-mail utility now offers a Windows interface and more features.

scans the network at login for available servers and loads only the drivers necessary to connect to those servers in order to conserve memory. POWERlan and WfWG both tie up more memory by

requiring multiple redirectors to accomplish the same thing. Additionally, LANtastic is the only one in the group that includes a Novell-licensed copy of the NCP drivers.

Previous versions of LANtastic offered e-mail, but only through a crude DOS utility with limited features. The Windows-based Artisoft Exchange Mail utility included in 6.0 supports a wider range of features than its predecessors, including binary attachments, folders, address lists, and multiple delivery options, such as priority or receipt. WfWG and POWERlan offer similar features through their e-mail packages. Exchange Mail also allows you to send and receive faxes when used in conjunction with a Communicating Application Specification (CAS)-compatible fax card. This is a useful feature, but since most fax modems are not CAS-compatible, its usefulness is limited. WfWG supports faxing through e-mail and works with any fax modem. POWERlan's da Vinci Mail does not include fax support.

LANtastic's e-mail also includes the ability to send mail to pagers such as those

Continues on page NE22

► CONFERENCING SOFTWARE

Don't Change That Channel

BY JOE SALEMI

There aren't enough hours in the day to hold the meetings you'd like to be able to have with your group. So use the network for your discussions.

TEAM Software's Channels offers conferencing features and can integrate tightly with existing e-mail packages to provide a comprehensive setting for workgroup discussions. However, it may not suit every network environment because it requires a dedicated

server and it does not support Novell's IPX protocol.

Channels is like an electronic bulletin board system (BBS) for your network: It gives you the ability to hold public and private discussions on the LAN. The discussion messages are stored on the LAN, and the users can read and respond to them when they log on. Channels also provides other groupware functions such as real-time user-to-user chats and integration with Microsoft Mail, Lotus

Continues on page NE26

Artisoft

CONTINUED FROM NE21

used by SkyTel. WfWG requires a third-party product to send pages. da Vinci Mail, which is included with POWERlan, does not support this feature at all.

The Artisoft Exchange Scheduler, a completely new feature, allows you to set up group and personal meetings over the network. It can also warn you of conflicting schedules and notify you of upcoming meetings. WfWG offers similar features through Microsoft Schedule+, while POWERlan does not currently offer any scheduling features.

Printer sharing is also improved in 6.0 with support for print-only servers. Previously, LANtastic print servers had to

NetWare or LANtastic?

Client/server networks like NetWare offer certain advantages, while peer-to-peer LANs like LANtastic offer others. Here are some of the primary strengths of each package:

NetWare	LANtastic
• Can run server-intensive applications (databases, for example). • Can support unattended server operations (backup jobs, for example). • Offers the ability to connect two or more LANs to form a WAN.	• Offers quick setup and easy installation. • Permits easy networking of CD-ROM drives and printers. • Includes client support for multiple-network environments.

act also as file servers and therefore had to load extensive server code into memory. Version 6.0 allows a PC to act as a print server and a client, which means that more memory will be available on that PC. WfWG offers the same capability. POWERlan, on the other hand, takes net-

work printing a step further with a feature called *class printing*, which allows you to set up similar printers in groups. Users then select a class, and their print job is handled by the next available printer in that class.

LANtastic's new burst-mode file-transfer feature, which is similar to the IPX burst-mode utilized by NetWare 3.12 in that it allows you to send several packets across the network without waiting for an acknowledgment of each packet. This can dramatically enhance network throughput, but will be most noticeable when sending large files, such as graphics or backup jobs, across the network.

Peer-to-Peer Network Operating Systems

	LANtastic	POWERlan	Microsoft Windows for Workgroups
■ = YES □ = NO			
List price (per node)	\$119	\$99	\$220
Windows interface	■	■	■
E-mail capability	■	■	■
Chat capability	■	■	Optional
Scheduling capability	■	□	■
Network DDE support	■	□	■
Disk cache included	■	■	■
SNMP agent included	□	□	□
Peripheral Support			
CD-ROM sharing	■	■	■
Modem sharing	□	Optional*	Optional*
UPS	■	■	□
Security			
Administrator can:			
Configure groups of users	■	■	□
Set account expiration date	■	■	□
Set log-on time restrictions	■	■	□
Password-protect specific resources	□	■	■
Assignable file-protection rights:			
Create	■	■	□
Delete	■	■	□
Execute-only	■	□	□
List	■	□	□
Read-only	■	■	■
Write	■	■	□
Printing			
Displays print queue	■	■	■
Allows job deletion	■	■	■
Alerts user to empty paper trays	■	■	■
Protocol Support			
AppleTalk	Optional	Optional*	Optional
IPX	■	□	■
NetBEUI, NetBIOS, and TCP/IP	■	■	■
Memory Requirements			
Minimum client RAM	29K	15K (without NetBIOS)	4K
Minimum server RAM	51K	35K	4K

*Via a third-party product.

MANAGEMENT

Both LANtastic and POWERlan include management utilities for keeping track of individual users and for limiting network access based on time, date, account, or password expiration. WfWG offers password protection but does not allow you to limit access by criteria such as time of day.

In addition to basic security management, LANtastic now allows you to monitor configuration information, status, and performance statistics for all of your servers so that you can see exactly which part of your network needs to be changed or improved. Neither WfWG nor POWERlan offer any centralized utilities for monitoring performance statistics of remote servers.

LANtastic 6.0 offers a host of improvements over previous versions and is an excellent NOS for small offices and workgroups. WfWG and POWERlan are equally impressive, and even more so in some respects. However, LANtastic's universal redirector, strong management and security, and good e-mail and scheduling features make it a strong contender.

• List price: LANtastic, Version 6.0, \$119 per user; Artisoft Inc., 2202 N. Forbes Blvd., Tucson, AZ 85745; 602-670-7100; fax, 602-670-7101.

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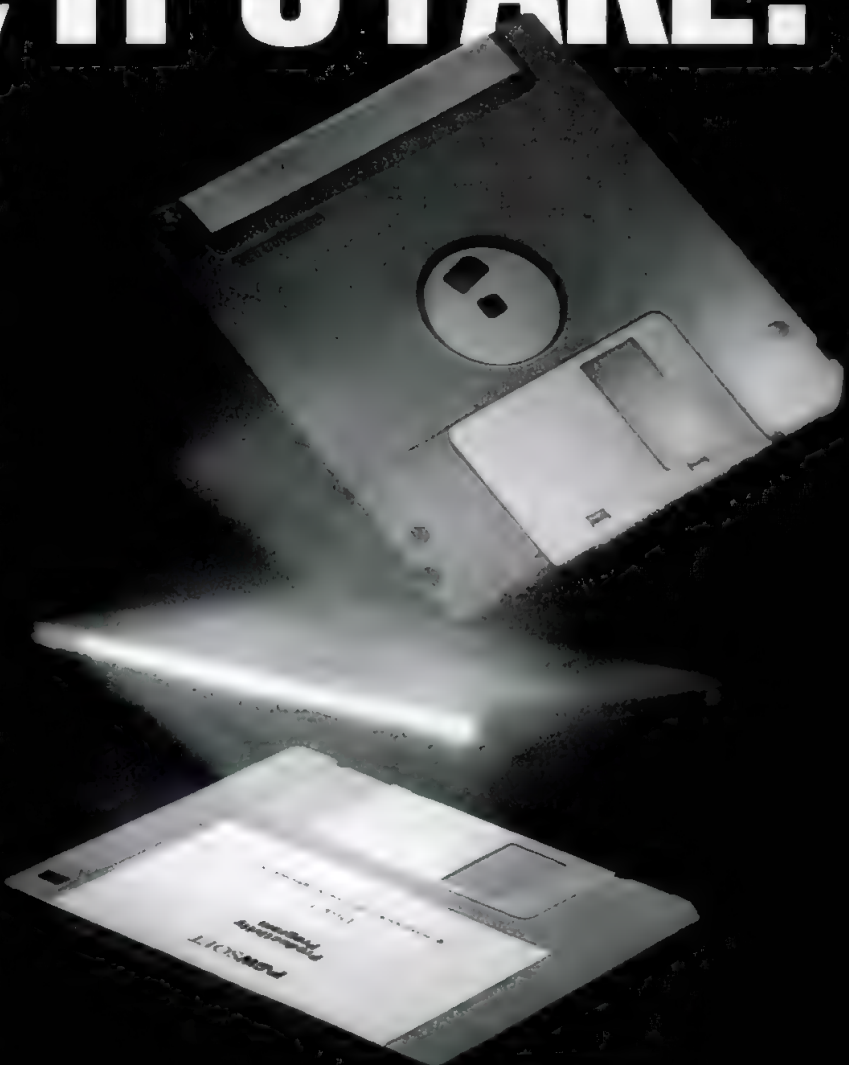
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TEAM Software

CONTINUED FROM NE21

cc:Mail, and other e-mail packages compliant with Vendor Independent Messaging (VIM) or Microsoft Windows Messaging API (MAPI). Channels can also be set up to support discussions over WAN connections.

Channels offers a similar interface and some of the same features as Lotus Notes and other more powerful groupware products. Discussion messages are stored in a database on the network file server. The database is managed by the Channels Communication Server software, which runs on a dedicated PC. Channels clients can access and participate in any discussion for which they have access rights, but can only initiate a discussion if their account is set up to support that right by the network administrator.

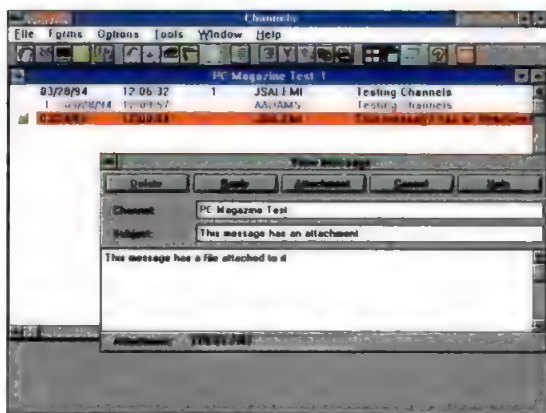
During installation, Channels can be enabled to support either Microsoft Mail, cc:Mail, or any other VIM- or MAPI-compliant e-mail system. It fully integrates with the e-mail system so that the Channels Windows interface can replace the mail front-end you're already using and provide your users with a completely integrated environment.

Channels discussions can also be made available to users on multiple LANs via the network e-mail system. The Replication Server software uses the mail transport to move conference messages between Channels' systems on different networks in a WAN environment. To use the Replication Server, you have to enable the Communication Server for e-mail and create a mailbox for it. The downside is that the Channels system on each network requires a dedicated Communications Server. Additionally, Channels doesn't include support for NetWare's IPX; it uses NetBIOS or TCP/IP as the transport protocol.

CHANNELS OF THOUGHT

Each discussion thread is called a *channel* (hence the product's name) and is

grouped by topic for easy viewing and navigation by users. The channels are very similar to a discussion area in a CompuServe forum. Messages are shown in a hierarchical list, with the initial message title indicated in bold. When you click on the subject, a sepa-



DISCUSSION TIME: Channels' discussion threads are structured for easy viewing and navigation.

rate window opens up and displays the text of the message. If you enable Channels for e-mail, non-Channels users can also participate in the discussions by mailing messages to the channel name instead of to a specific user's address. This type of access is very limited, though, since non-Channels users can't

real-time message directly to another user on the system. All of these messages are stored in Channels' database, so a user doesn't have to be logged onto the system to receive them; they can be read the next time the user logs into Channels.

Installing Channels is a fairly straightforward process, though you have to set certain LAN system parameters first. The most important step is to create a network logon ID for the Communication Server, providing full read and write access to the Channels directories on the server. You then log onto the network from the soon-to-be Communication Server and install the software.

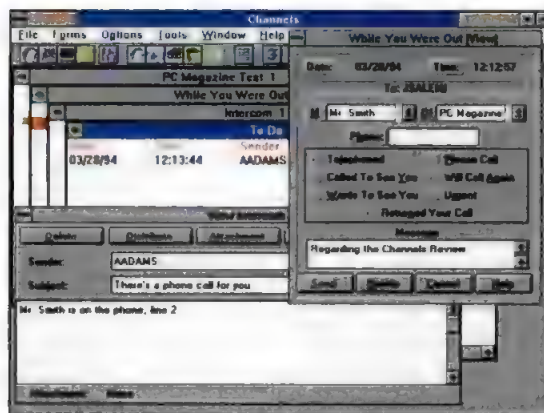
The final step is to start the Communication Server and log into it from one of the Channels clients to create user IDs (you can't log in directly at the server). Channels doesn't use the network Bindery or user list to generate its own access list, but it can use the e-mail directory for sending mail messages. Users are added individually or as part of a group, with their access rights to different Channels functions established through a series of menus and buttons. The Communication Server must be dedicated unless it's running Microsoft Windows for Workgroups or Windows NT, both of which allow you to log into multiple network sessions (one as the Communication server, one as a client).

Channels provides good conferencing features at a reasonable price and has a number of other groupware features that can prove handy in many office situations. Just remember that you have to dedicate a PC as a server and that you have to run a NetBIOS or TCP/IP driver if you want to use Channels in a NetWare environment.

• List price: Channels, Version 1.0a: \$55 per user

(available in 10-, 20-, 50-, and 100-user packages; the 100-user package carries a 10 percent volume discount); TEAM Software Inc., 5858 Westheimer St., Houston, TX, 77057-0759; 800-785-1112, 713-784-4480.

Circle 966 on reader service card



USER-TO-USER: Channels includes an on-line chat feature and lets you send "While You Were Out" messages.

read the other messages in the channel.

Channels' other user-to-user communication features include the ability to post "While You Were Out" messages for another user. Also, users can set up private or public on-line to-do lists. Finally, a chat feature lets Channels users send a

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► MULTIMEDIA NETWORKING

Novell Tries Out Networked Video

BY JEFFREY D. BAHER

Novell already controls most of the networking market, so it's no surprise that the company is playing a major role in the latest rage: bringing video to the network. NetWare Video, Version 1.0, a NetWare Loadable Module (NLM) for NetWare 3.x and 4.x environments, theoretically allows as many as 25 users to access Audio-Video Interleave (AVI) video files stored on a server. But don't be fooled: Delivering video over a network is not a simple task, and NetWare Video is by no means a complete solution for doing so. You'll need high-end clients and servers, as well as additional software, to establish video service on your network; even then you'll be lucky to support 10 users per network segment.

The main problem associated with networked video is that it can seriously hinder network throughput because the files it utilizes are so large. Successful playbacks over the network, or *sessions*, require a steady, continuous stream of data to the client, which can be difficult for a congested network to achieve when that data is stored in a very large file. NetWare Video addresses this problem by separating the audio and video portions of these files and by scaling down the video files as necessary.

NetWare Video separates audio from video at the server before transmission. The two are then recombined at the client by a NetWare Video driver. If the client cannot receive the video file quickly enough (because of memory constraints or a slow CPU, for example) or if there isn't enough bandwidth available to pro-

vide a continuous flow of data, NetWare Video will reduce the size of the video file by dropping images.

The video portion is made up of a series of images called *keyframes* and transitional images that show the motion between them. Because the transitional frames are less important to the overall video than the keyframes, NetWare Video drops them as necessary to reduce the file size. However, if a lot of frames drop, the fluidity of the video may be thrown off so much that it becomes choppy and difficult to watch. And this is where NetWare Video's shortcomings showed: On our ten-client test-bed with only two clients accessing video files, NetWare Video dropped enough frames to have a noticeable, even annoying, effect on video sessions.

Starlight Networks' StarWare NLM, the only other available video software for NetWare, sacrifices the number of available concurrent video sessions in favor of maintaining the highest-quality playback. In this way, the number of

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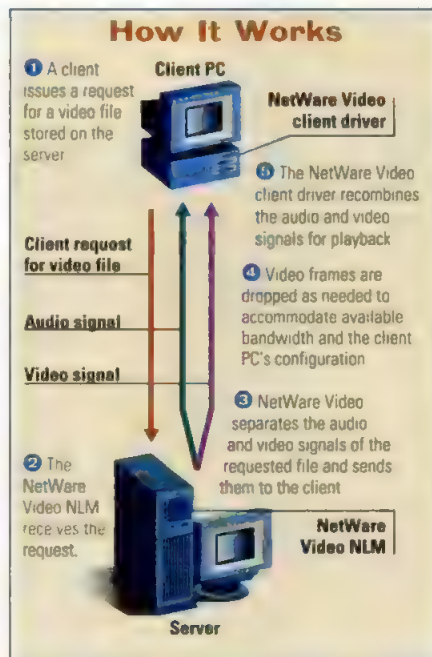
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CIRCLE 887 ON READER SERVICE CARD

video files traversing the LAN is limited and the effect on available network bandwidth is reduced. As a result, Starlight may deliver fewer simultaneous video sessions than NetWare Video, but the quality of each session should be better.

HIGH OCTANE REQUIRED

NetWare Video does not provide a complete network video solution: You need server and client PCs with plenty of memory and high-speed I/O capabilities as well as both Microsoft Windows 3.1 and Microsoft Video for Windows (or another application capable of playing AVI files) on the clients. For a 25-user license of NetWare Video, Novell's recommended minimum server configuration is a 486DX/50 server with 16MB RAM, a 32-bit network server adapter, hard disks with 10-millisecond access time and a 4-megabyte-per-second transfer rate, and 32-bit disk controllers. Novell recommends that clients be at least 386/25s with 4MB RAM and a VGA card with 1MB



video memory and a 256-color driver. However, we found during our tests that more robust client PCs are required for NetWare Video to be

effective: Plan on 486s with at least 8MB of memory.

Finally, our tests on an Ethernet network indicated that a single segment with virtually no other traffic can have difficulty with fewer than 10 NetWare Video clients. The 25-user license is an unrealistic configuration for a single network segment—6 to 10 users on each of four segments is a more appropriate scenario to support 25 users. You may also want to consider higher-speed network technologies, such as Token-Ring, switched Ethernet, or FDDI to augment your network video setup.

NetWare Video is a valuable tool, but it is only one piece of the puzzle. It can play a crucial role in your video setup—once you have the other pieces of the puzzle in place.

► **List price:** *NetWare Video, Version 1.0:* 5-user license, \$1,100; 10-user license, \$1,990; 25-user license, \$2,975. Novell Inc., 122 East 1700 South, Provo, UT 84606-6194; 801-429-7000; fax, 801-453-1267.

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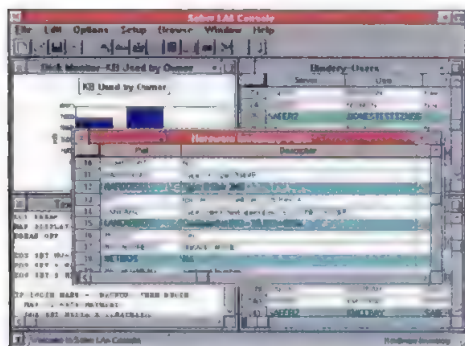
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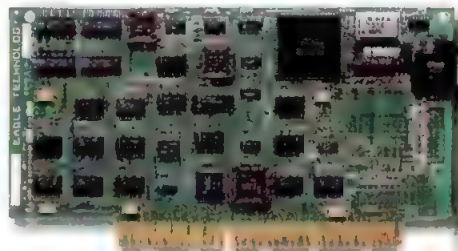
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Leave a Message at the Tone

BY JEFFREY D. BAHER

When is a phone call not a phone call? When it doesn't take place over a phone.

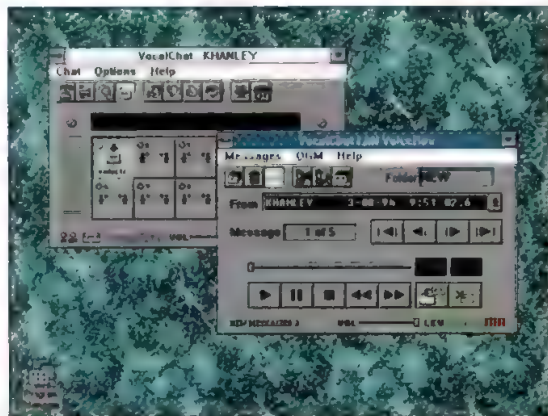
VocalChat, Windows-based intercom and voice-mail software for NetWare LANs or WANs, allows users to talk to each other over a network by equipping their PCs with microphones and sound cards. It won't replace your phone or voice-mail system, though, because it doesn't let you hold fluid conversations and it doesn't support phone calls.

The software operates on any PC running Microsoft Windows and in any NetWare environment (Version 2.x or later). It works with sound cards from a number of vendors, such as Media Vision and Creative Labs. VocalTec also offers its Compact Audio Technology (CAT) card (\$179), a sound board that plugs into

any PC or laptop parallel port.

VocalChat also requires a handset or microphone for transmitting and receiving voice and a network adapter for access to the LAN or WAN.

We installed both the VocalChat software and the CAT sound card in our NetWare 3.11 environment without a problem. To launch VocalChat, simply double-click on the application icon in the Program Manager. VocalChat checks the NetWare Bindery and Service Advertising Protocol broadcasts to gather information on all available NetWare servers as well as all users and groups. To initiate a call, select a user or group from a menu and click the Dial button. If the selected user has VocalChat installed, the call will go



"I'M NOT IN RIGHT NOW...": VocalChat's LAN VoiceBox feature lets your PC act like an answering machine.

through. If not, the sender will receive a message saying that the call could not be completed.

While placing calls is effortless, the actual conversations can be difficult. Sound cards do not support bidirectional communication. Instead, VocalChat connections are much like walkie-talkie connections: You must click on the Send but-

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System Requirements: Requires Novell NetWare 2.x or above, or NetWare 360. Includes VAP and NLM. No TSR required. AppMeter is a trademark of Funk Software, Inc. © 1994 Funk Software, Inc., 292 Third Street, Cambridge, MA 02142. Tel (617) 497-0330 Fax (617) 547-1031. Developer tested only. Novell makes no warranties with respect to this product.



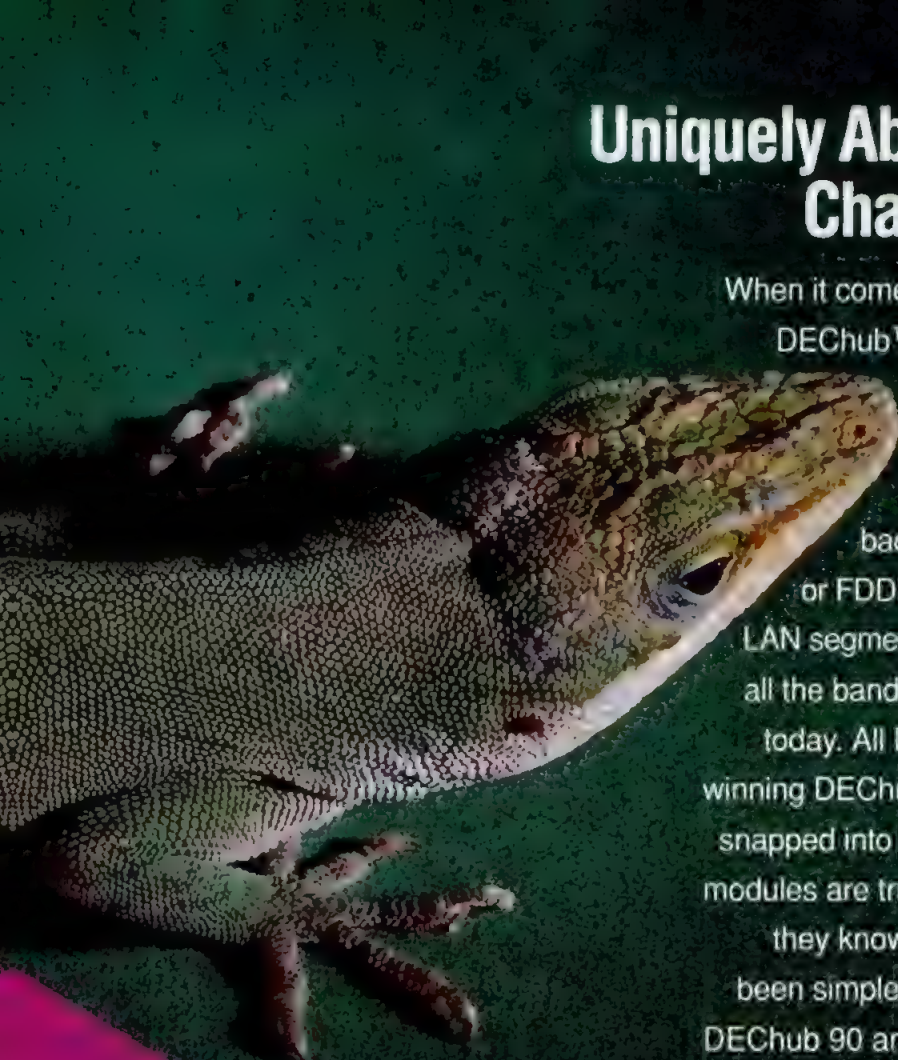
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When faxing, the server makes use of all of the shared fax-modems in the modem pool for receiving or for simultaneous broadcast faxing to multiple recipients. Incoming faxes can be automatically or manually routed. It can keep track of all faxes and data transfers through powerful administrative options including full reporting, logging, and diagnostics.

The Eclipse Fax and Terminal Plus clients co-operate seamlessly with the fax & communications server. The integration in Windows is so discrete and so transparent that users won't even know they are using a shared network modem.

Most importantly, there are no TSR's stealing valuable memory and hidden under Windows.

The Award Winning Eclipse Fax with OCR

Eclipse Fax for Networks allows multiple users to forward faxes to the fax server for onward transmission. This lets users get back to work quickly without waiting for their fax software to finish transmitting from their workstation. Users can command all of Eclipse Fax's powerful features including the built-in OCR plus new network ready features including network based multi-user phone books, network attachments, and bulk faxing.

The Award Winning Terminal Plus

Terminal Plus for Networks supports all the popular terminal emulations, file transfer protocols and all the different types of modems. It's the best way to connect quickly and reliably to all of the popular online services including CompuServe, Dow Jones, the Internet... Terminal Plus for Networks has all of the great features both novices and experts want in an easy to use and network ready data communications software.

The Economical Solution

The Best Fax & Communications Suite for Networks is also the best value. Call today.



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CIRCLE 940 ON READER SERVICE CARD

Network Edition

FIRST LOOKS

ton to speak, and the receiving end must be in listening mode to hear you. However, VocalChat includes an optional voice activation feature, which automatically switches you into speaking mode when you're talking. We found voice activation helpful, but a VocalChat conversation is still not quite like a real phone conversation.

VocalChat also includes a handy voice-mail function called LAN Voice-Box, which lets you record outgoing greetings and play back voice-mail messages just like an answering machine. In fact, configuring it is just like setting up an answering machine: You record a greeting and enable the auto-answer feature from VocalChat's main menu. With auto-answer enabled, VocalChat sends incoming calls directly to voice mail. Messages are stored as .WAV files, which can take up considerable disk space (one 60-second message consumes almost 65K). This feature is very useful, but VocalChat won't replace voice mail entirely because it does not allow you to call outside the network or receive telephone calls.

Sending voice messages over the network raises the question of bandwidth consumption. Fortunately, VocalChat can compress voice signals down to 4 kilobytes per second—roughly 40 calls per megabyte of bandwidth consumed. Even with multiple conversations, we saw very little effect on our Ethernet network's performance.

VocalChat may be a little too bandwidth-greedy to use on a WAN connection, though, since even high-speed T1 lines support only 1.544 megabits per second. To combat this problem, VocalTec offers VocalChat WAN, which is the same software bundled with VocalTec's Voice Compression Card. The card can compress a conversation to a scant 800 bytes of bandwidth, allowing nearly 1,000 calls to run simultaneously over a single T1 line.

VocalChat is not flawless, but it certainly goes a step beyond e-mail to improve interoffice communication. It could even help reduce the number of Post-Its people leave around your PC.

► List price: *VocalChat*, \$199; *VocalChat WAN*, \$399. *VocalTec Inc.*, 157 Veterans Dr., Northvale, NJ 07647; 201-768-9400; fax, 201-768-8893. Circle 965 on reader service card

**At last count,
there were nearly 3 million
notebook PCs out there.**

**And more than
30 million networked
desktop PCs.**

So what's the connection?

National

We'd like to let you in on one of the best kept secrets in the industry: National Semiconductor has quietly become one of the most experienced companies in the field of networking.

In fact, there's a very good chance that, if you work in a network of PCs, you've worked with us before. Because 2 out of every 3 Ethernet cards installed in desktop PCs today use chips designed by National. You see, we sell our fast, reliable Ethernet chips to other companies who, in turn, design

them into the boards they sell.

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The ideal family of network products designed to make it easier for people to work together.

For typical desktop PC environments, there's our easy-to-install NE2000plus Ethernet cards that make it easier for a large group of people to work together better—and faster. Of

course, for PC workstations and file servers, you can use our high-performance FDDI cards.

Finally, for those who value mobility, there's our equally-easy-to-install InfoMover NE4100 PCMCIA Ethernet Adapter for notebook PCs with a Type II slot. Unlike PCMCIA cards available from some other premium suppliers, the NE4100 fully



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For those of you who want
the security of knowing
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InfoMover cards are all
that—and more.*

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supports industry-standard card and socket services. In fact, with InfoMover

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*Thanks for the support.
We offer 24-hour-a-day,
7-day-a-week, toll-free
technical support. And
InfoMover products come
with a lifetime warranty.*

software installed on your notebook, PCMCIA cards—such as our NE4100 card, as well as memory expansion cards and modems—can be “hot-swapped.”

This means PCMCIA cards can be inserted and removed without the notebook being turned off each time.

Now before you ask, we want to assure you that all InfoMover products have been codeveloped with Novell to ensure that



Give us a ring.

We've put together a short, informative videotape that outlines the advantages of the InfoMover product line. Just dial 800-227-1817, ext. 32. The call and the tape are free.

they'll seamlessly integrate with NetWare® environments. And, best of all, they're compatible with virtually all industry-standard hardware and software—

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The InfoMover NE4100 PCMCIA Ethernet Adapter supports card and socket services so it can be “hot-swapped,” inserted into or removed from a notebook while it's on.



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NEW & IMPROVED

NEWS OF ANNOUNCED NETWORK PRODUCTS AND UPGRADES

By Vicki B. Jacobson

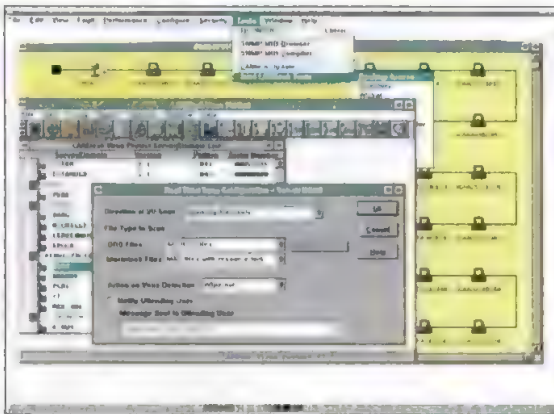
NEW

Intel Steps Up Network Management and Analysis

Intel Corp. promises to increase the level of control in its LANdesk management products for LAN and enterprise-wide environments. The new versions of LANdesk Virus Protect and LANdesk Traffic Analyst and the new LANdesk OpenView for Windows step up the products' security, troubleshooting, and performance analysis.

LANdesk Virus Protect protects NetWare LANs from known and unknown viruses. Version 2.1 can now run as an NLM on Novell's NetWare Management System, providing a single point of control.

Version 2.0 of LANdesk Traffic Analyst is now available for Windows users as well as DOS users. The current version of this software provides packet and monitoring capabilities for both Ethernet and Token-Ring NetWare LANs.



ON GUARD: LANdesk Virus Protect checks for known and unknown viruses.

In a collaboration with HP, Intel is now offering LANdesk OpenView for Windows. It integrates Intel's LANdesk Manager, Version 1.51, and LANdesk SNMP Gateway, Version 1.5, with HP OpenView for Windows, Version 7.1.

- List price: *LANdesk Virus Protect, Version 2.1, \$995; LANdesk Traffic Analyst, Version 2.0, \$995; LANdesk OpenView for Windows, \$2,495.* Intel Corp., 2200 Mission College Blvd., P.O. Box 58119, Santa Clara, CA 95052-8119; fax, 800-525-3019.

Circle 954 on reader service card

IMPROVED

Edify Accesses Your Office from the Road

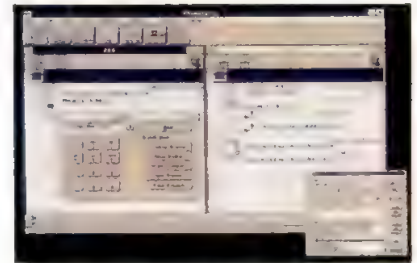
Edify Corp. lets you keep in touch with the office while you're out on the road. It has added interactive voice-response technology to its Electronic Workforce remote-mail software, allowing mobile PC users to use a Touch-tone phone or fax to access and retrieve electronic mail and database information. Users can have messages spoken or faxed and access a database to take action on any of the messages. Electronic Workforce can be used in conjunction with a variety of e-mail packages, including Microsoft Mail, Lotus Notes, cc:Mail, WordPerfect Office, Digital Equipment Corp.'s All-in-One, HP Deskmanager, and IBM PROFS, among others. Supported databases include Oracle, Sybase, DB2, and Btrieve.

- List price: *Electronic Workforce, pricing dependent on configuration.* Edify Corp., 2840 San Tomas Expwy., Santa Clara, CA 95051; 408-982-2000; fax, 408-982-0777.

Circle 955 on reader service card

HOT PROSPECT

Call and Leave a Message On My...Computer?



Screening your calls takes on a new meaning when you use SoftTalk Communications' Phonetastic, one of the first computer telephony products.

Phonetastic lets you control your phone over a local area network. Users can customize it to work with their own databases, personal information managers, and contact managers.

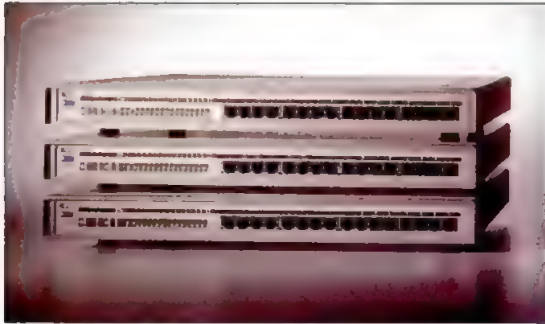
The Windows software makes it easy for users to customize basic procedures such as call waiting, conference calls, and call transfer. Users can manage and access multiple calls simultaneously and can also schedule calls in advance. Call monitoring allows users to connect each call with related database information. Phonetastic supports NetWare, IBM's LAN Manager, Microsoft Windows for Workgroups, Apple's AppleTalk, and TCP/IP.

- List price: *Phonetastic, 10 users or more, \$250 per user.* SoftTalk Communications Ltd., 20 Galgalei Haplada St., Herzlia, Israel 46105; 972-9-584684; fax, 972-9-543917.

Circle 962 on reader service card

NEW

Lannet Offers Intelligent Stackable Hubs



SMART STACK: Up to five LANstacks can be linked, for a total of 80 managed ports.

Combining the features of a chassis-based hub with the flexibility of a stackable hub is a high-priority item for hub vendors. Lannet Data Communications' 8-port (SH-E8 and SH-T8) and 16-port (SH-E16 and SH-T16) LANstack intelligent stackable hubs offer port redundancy, segmentation, and plug-in management, features more typically found on chassis-based hubs. Linking up to five managed Ethernet or

Token-Ring LANstacks (or a combination of both), network managers can take advantage of up to 80 ports for as little as \$86 per port.

Management is provided via a plug-in SNMP module: SH-EMA or SH-TMA.

• List price: LANstack hubs: (Ethernet) SH-E8, \$750; SH-E16, \$1,195; (Token-Ring) SH-T8 and SH-T16, pricing to be announced. Management modules: SH-EMA, \$895; SH-TMA, pricing to be announced. Lannet Data Communications Inc., 7711 Center Ave., #600, Huntington Beach, CA 92647; 800-552-6638, 714-891-5580; fax, 714-891-7788.

Circle 956 on reader service card

NEW

Make Systems Eases Your Management Woes

A new suite of application tools from Make Systems lets you target troublesome network management areas. Collectively, the NetMaker XA (eXtensible Architecture) tools address capacity planning, network failure analysis, inventory management, traffic analysis, network design, and network usage chargebacks. Each of the following applications—sold separately—includes the NetMaker XA engine: Accountant (for financial modeling and accounting), Analyzer (for identifying network problems when troubleshooting), Designer (for optimizing the cost and performance of the network), Interpreter (for analyzing LAN/WAN communication), Planner (for engineering network changes), and Visualizer (for managing network data).

• List price: NetMaker XA: Accountant, \$9,995; Analyzer, \$9,995; Designer, \$14,995; Interpreter, \$6,995; Planner, \$14,995; Visualizer, \$6,995. Make Systems Inc., 201 San Antonio Circle, #225, Mountain View, CA 94040; 415-941-9800.

Circle 957 on reader service card

IMPROVED

Alta Brings You Screen-to-Screen Messaging

Another way to replace the inefficiency of interoffice voice mail is to use the computer screen to do your messaging. Alta Research Corp.'s adapters now come bundled with Cross International's NetTalk software to send screen-to-screen messages. Alta's EtherCombo-16 for 10BaseT and 10Base2 networks and the EtherTPI for 10BaseT networks are both now being sold with the telephone-message pop-up program NetTalk. Windows and DOS users can trade messages in real time.

• List price: EtherCombo-16, \$99; EtherTPI, \$89. Alta Research Corp., 614 S. Federal Hwy., Deerfield Beach, FL 33441; 800-423-8535, 305-428-8538.

Circle 958 on reader service card

BRIEFS

HUBS

Alantec Corp. has enhanced its PowerHub LAN segmentation device while bringing the cost of intelligent switching down to \$296 per port. The PowerHub Model 5000 (reduced from \$27,950 to \$22,500) now features enhanced IPX and AppleTalk Virtual LAN capabilities, an IP helper function for forwarding nonroutable TCP/IP protocols, and several types of network boot capabilities. 800-252-6832.

Standard Microsystems Corp. combines Ethernet, FDDI, and Token-Ring bridging and routing in its intelligent switching hub. The Elite SwitchingHub ES-1 supports source routing, transparent bridging, and transparent spanning tree methods. Pricing depends on the configuration. 516-273-3100.

ADAPTERS

Newport Systems Solutions Inc. has boosted the flexibility of its WAN adapter, adding support for a variety of Novell's communications products, including NetWare Connect, NetWare for SAA, and Link/X.25. The Wide Area Network Interface Coprocessor, Revision E (\$1,095), available in ISA, EISA, and Micro Channel versions, provides high-speed WAN access for NetWare LANs. 714-742-1511.

Socket Communications' newest PCMCIA adapter provides support for 10BaseT and 10Base2 networks. The \$369 Socket EA+ adapter is compatible with the NE2000 controller, allowing it to work with drivers from popular operating systems such as NetWare 3.x and 4.x and Microsoft Windows for Workgroups. The EA+ also boasts low power consumption: It conforms to the Intel ExCA power specification. 510-670-0300.

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With their unparalleled reliability, you can count on Proteon ProNET-4/16 Plus Token Ring adapter cards to last a lifetime...and then some. Which is exactly why we can back every one with our full Lifetime Warranty. Simply put, you can have confi-

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cards, because they're

an investment that

All ProNET Token Ring adapter cards also come backed with our 100% Interoperability Guarantee. So whether you use them in your individual PC or in your server, they're totally compatible with any network operating system, hardware environment or application software you may have up and running. Otherwise, we'll refund your money. It's the ultimate combination of dependability and award-winning performance. And

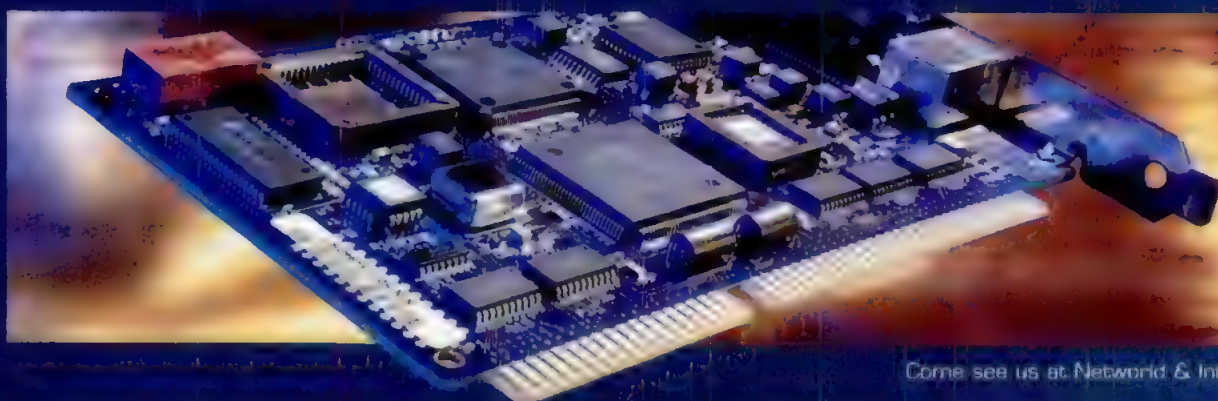
only Proteon has the technology to deliver it to you in writing.

In addition, these Proteon ProNET Token Ring adapter cards are totally software configurable, so installation is refreshingly simple. Plus, they're available for ISA, EISA and MCA architectures.

All of these features will undoubtedly add up to make your job a whole lot easier. Namely,

by providing you with the most reliable and versatile Token Ring adapter card available. So call 1-800-830-1300, Dept. 400 (or fax 508-366-8901) to get the facts on the ProNET Series cards and their unrivaled warranty/guarantee. Then look into getting a Proteon ProNET adapter card for your system. Put it in. Put it to work. And put it out of your mind.

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Insomniac software developers.

NEC
Express RISCserver

**And database managers who'd like to get
home sometime before the farm report.**

[The dawn of Windows NT and NEC MIPS RISC computing.]



mips
Open RISC Technology

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So that database managers could get home from work at a reasonable hour, the developers of Windows NT™ watched many sunrises from behind their MIPS® RISC computers.

(They chose machines built around the MIPS RISC architecture for two basic reasons: sheer performance and superior technology. Fact is, the NEC V_R4400™ MIPS processor is at the heart of some of the most powerful computers in the world.)

Was it all worthwhile? Absolutely. First, Windows NT lets companies move their information management into the future without missing a beat. Or shutting down their mainframes.

Second, the brilliant new database management application made possible by Windows NT—Microsoft SQL Server—makes managing databases simpler. And gets enterprise information to end users easily and fast.

Third, the direct descendant of the machines used to *develop* Windows NT—the powerful, dependable NEC Express RISCserver™—is now available to *run* a new generation of programs. Which means they will run quickly, seamlessly, smoothly. Allowing database managers everywhere to sleep a lot better.

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Microsoft

SQL Server

for Windows NT

MIPS edition

And the rest is history.

NEC

IMPROVED

Boca Offers All-in-One Modem

Boca Research provides complete communication services on one line—voice mail, fax, and data—to mobile users by bundling its 14.4-Kbps Multimedia Voice BocaModem with SofNet's FaxWorks Voice, Version 3.0. By attaching the modem to a PC, users can set up a message-handling system that can be accessed via a Touch-tone phone.

The modem provides throughput up to 57.6 Kbps (via data compression). The software supports up to 1,000 password-protected mailboxes and features fax retrieval, a message-checking pager, and fax notification capabilities.

• List price: *14.4-Kbps Multimedia Voice BocaModem with FaxWorks Voice, Version 3.0*, \$245. **Boca Research Inc.**, 6413 Congress Ave., Boca Raton, FL 33487-2841; 407-997-6227.

Circle 959 on reader service card

NEW

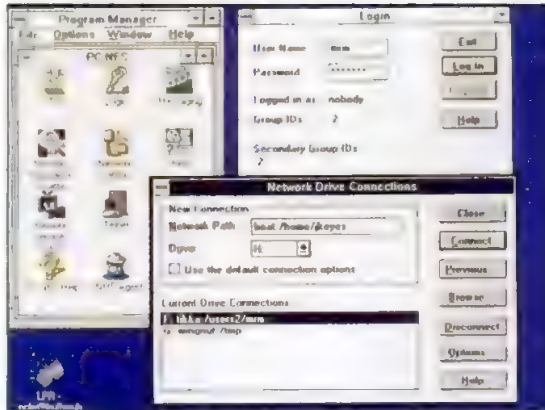
TCP/IP Moves onto the Desktop with SolarNet

SunSelect wants to make connecting to Unix systems less intimidating for PCs. Its new **SolarNet** software gives PC users access to the Unix environment and gives network managers a single view of the network.

By bringing TCP/IP to the desktop, this software gives network managers a new level of control over their PCs. The PCs gain full access to the Unix network, allowing users to access applications and data that reside on large Unix computers.

• List price: *SolarNet*, pricing to be announced. **SunSelect**, Two Elizabeth Dr., Chelmsford, MA 01824-4195; 508-442-2300; fax, 508-250-2300.

Circle 960 on reader service card



THE BIGGER PICTURE: SolarNet uses TCP/IP to bring PC users to the corporate community.

IMPROVED

Tally Up Your Network

The latest version of **Tally Systems Corp.**'s **NetCensus** software provides automatic inventory for a wider variety of desktop systems than the previous release. Sporting a new Windows interface, Version 2.0 now supports Macs in addition to DOS, Windows, and OS/2 workstations and file servers.

Its software-inventory capabilities include identifying programs by brand name, version number, and embedded serial number. **NetCensus** recognizes most popular PCs, add-on drives, processors, and other hardware devices. This latest release also features **MacCollector**, which automatically collects hardware and software inventory for Macs, and new reporting features.

• List price: *NetCensus, Version 2.0*, \$10 to \$20 per PC (depending on the number of PCs). **Tally Systems Corp.**, P.O. Box 70, Hanover, NH 03755-0070; 800-262-3877, 603-643-1300; fax, 603-643-9366.

Circle 961 on reader service card

BRIEFS

BRIDGES

Combinet Inc. has reduced the price of high-speed remote access with the introduction of its **Everywhere 160** ISDN bridge. Users no longer have to purchase and install a separate and typically expensive NT1 link (the interface that connects conventional two-wire phone lines and four-wire ISDN lines). **Combinet** provides the connection in this \$1,190 unit. 408-522-9020.

Acsys Inc. targets the Token-Ring switching market and, more important, stresses the importance of its smaller-size packets with the **Token-Switch 3000** bridge/router (\$3,990). The two-port IPX and TCP/IP Token-Switch can forward up to 38,000 28-byte frames per second. The bridge/router features support for IBM LAN Manager and IBM LAN Network Manager/NetVIEW. It also supports SNMP MIB II systems such as HP OpenView, SunNet Manager, and IBM NetVIEW 6000. 617-275-4455.

SERVERS

DigiBoard's new **PortServer** provides users with access to a TCP/IP host, regardless of their location on the network. The 8- or 16-port terminal server (\$1,595 or \$2,195, respectively) features a 20-MHz 80186 processor, 1MB of RAM, and throughput up to 57.6 Kbps. The **PortServer** provides both 10BaseT and 10Base2 connections. 612-943-9020; fax, 612-943-5398.

Telco Systems Network Access Division introduced a new server that can accommodate traffic from voice, data, graphics, and video applications. The **Access60** Network Access Server (\$6,500 to \$20,000, depending on configuration) accommodates virtual voice services, Switched 56/64, ISDN, frame relay, SMDS, and T1. 510-490-3111; fax, 510-656-3031.

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your high capacity data storage cartridge can withstand at least 2,000 passes and maintain an archival life of up to 30 years. Now that's durability. That's Maxell.

Advanced Tape Design

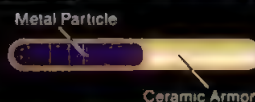
When it comes to tape design, Maxell continues to break new ground in 4mm technology with a new hub-

lock mechanism called Safe-T-Lock™. This new feature ensures that your tape spools remain slack free by keeping the hubs positively locked during transportation and handling. As a result, you're assured of proper tape tension when backing up.

Maxell also takes 8mm recording to a new level by introducing an all new coating formulation. This means higher durability, higher output, and the lowest error rates of any manufacturer. There just is no better 8mm data recording product on the market.

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CIRCLE 885 ON READER SERVICE CARD

RAIDION

FAULT-TOLERANT DISK ARRAYS

RAIDION® LT and LS Series disk array subsystems are designed for use with either Novell NetWare 3.1x/4.x or IBM OS/2.

Easy Upgrade.

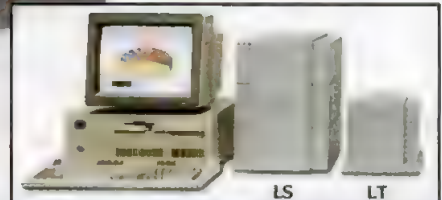
RAIDION, configured with 2 modules, provides mirrored fault tolerance up to 3 GB. Adding just one more module and installing RAIDWARE™, doubles user capacity and upgrades the array to RAID 5. Each array can be expanded to 32 modules and 93 GB.

Exceptional Warranty.

There is a full 5 year warranty on all Micropolis high-capacity disk drives. Other RAIDION components carry a 3 year warranty.

Hot-Swap and Hot Replacement features allow RAIDION to be serviced while your network remains up and running. In addition, RAIDION can be configured with an On-Line Spare, which activates automatically upon drive failure ensuring continuous fault-tolerant operation.

Award Winning. In a benchmark comparison of arrays, Corporate Computing said: "Raidion was our overall winner with an impressive combination of high performance, low cost, and unparalleled expandability." May 1993. RAIDION was also named LAN Magazine's Disk Array Product of the Year for 1994.



MODULE #	CAPACITY	LS	LT
		DRIVE FORM	
LM 1050	1,050 MB	LT 3.5-inch	
LM 1760	1,760 MB	LT 3.5-inch	
RM 2100	2,100 MB	LS 5.25-inch	
RM 3020	3,020 MB	LS 5.25-inch	

Other add-on module capacities available.

Economical. An LT Series three module 2 GB array is approximately \$6,500. An LS Series Raid 5 array with a capacity of 6 GB lists for under \$13,000. That's about \$2.00 per MB. RAIDION's low price makes fault tolerance affordable for any size network. **For the name of the reseller nearest you, call toll free 1-800-395-3748.**



MICROPOLIS®

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CIRCLE 914 ON READER SERVICE CARD

Should You Be Visiting the Virtual LAN?

Hub and router vendors have a new solution for a major problem plaguing today's corporate internetworks. Traditional LANs require you to plug and unplug cables in order to move users between segments. Virtual LANs, or *VLANs*, meld two technologies—switching and network management—in new ways to enable users on separate segments to be managed as if they were on the same physical cable. VLANs are LAN segments composed of users from multiple, often far-flung locations. VLANs will purportedly lower the cost and ease the process of adding, moving, and changing users on the network.

They offer some other advantages as well, like the elimination of broadcasts that would otherwise consume precious bandwidth, first-class network services for remote users, and the ability to place departmental servers at central locations without paying a performance penalty.

The big players are all announcing VLAN products. Cisco Systems just announced CiscoFusion, its switched LAN and VLAN strategy. Cabletron's MMAC-Plus is a high-end switched LAN hub-of-hubs with VLAN support, and SynOptics' Lattis System 5000 is a high-end hub with VLAN support. But if you're like most network managers, the issue isn't so much where you can get VLAN support as what it is and why you're going to need it.

VLAN EXPLAINED

Traditionally we think of LANs as networks made up of users attached to the same cable. In a VLAN, users aren't necessarily in close proximity or attached to the same cable, though the network manager can create new segments or move users from one segment to another from a central console without manipulating cables. With traditional LANs, the support staff costs required to add, move, or relocate a user typically range from \$150 to \$300. With a VLAN, these costs are reduced to nearly zero.

VLANs are made possible by switched LAN technology, in which hubs read addresses in data frames and set up connections as needed between senders and receivers. Port switching is the automation of moving users between ports on a hub. Segment switching brings increased bandwidth to switch traffic between LAN segments.

Traditional hubs are passive. They pass data but don't get involved in the transmission process. A hub's ability to create a VLAN is a natural byproduct of being involved in the addressing and connection management process.



Despite the benefits,
most network managers
are squeamish
about getting involved
with VLANs.

The management software that creates VLANs supports clustering of arbitrary sets of ports so that direct connections between any of the ports designated as part of a VLAN are always available. Just as all members of a physical Ethernet, Token-Ring, or FDDI segment receive all messages for all recipients, all members of a VLAN will be able to receive all messages destined for all recipients.

Hub vendors can also provide a number of value-added services that facilitate VLAN creation and management. These include:

- **Routing and encapsulation.** Because some vendors use proprietary protocols to implement VLANs, they can encapsulate those protocols within standard routable protocols, like TCP/IP, to extend VLAN support to remote users and those attached to passive, nonswitching hubs.
- **Security checks.** VLAN software can check for unauthorized users or transmissions.
- **Accounting and chargeback.** By noting the origin of each packet and keeping track of the bandwidth consumed over time, hubs and routers that implement VLANs can easily provide accounting and chargeback information.

Despite these benefits, most network managers are squeamish about getting involved with VLANs. A recent survey we conducted found that while many are actively planning deployment of switched LAN technology, most are doing so to obtain the benefits of increased LAN capacity. Managers perceived VLANs to be vulnerable to broadcasts and incompatible with existing routers. They felt that VLANs increased the complexity of management administration.

We probably all want to adopt a VLAN strategy for the future so we can transcend the boundaries of a physical connection. The best policy for now is to adopt at a slow pace. Wait until products from more vendors are available so you can evaluate more realistically the products that are being offered. Obtain details from your vendor regarding their implementation of broadcast traffic within VLANs; the coexistence of VLAN services with existing routers; and whether or not network management has been simplified for VLAN creation, monitoring, modification, and deletion. Only as a result of thorough investigation of these issues will you derive the best conclusions regarding where VLANs fit or do not fit within your network.

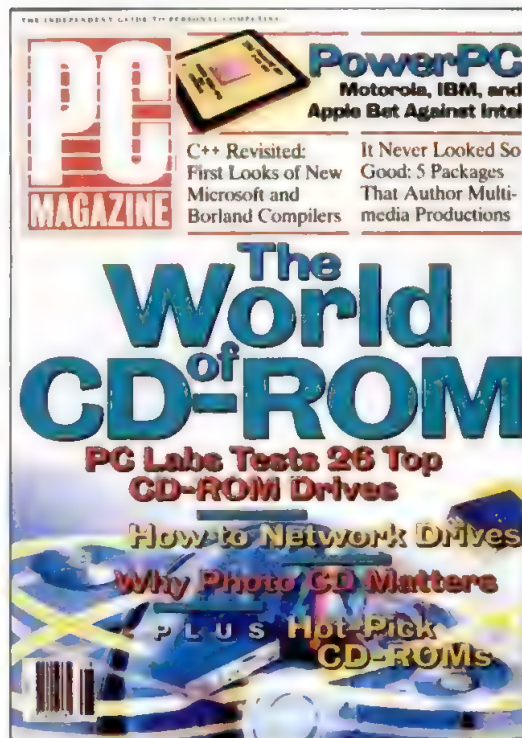
NICK LIPPIS is a contributing editor of *PC Magazine* and is president of Strategic Networks Consulting, a consultancy specializing in enterprise networking. He is also publisher of *The Internetwork Advisor*, a monthly newsletter.

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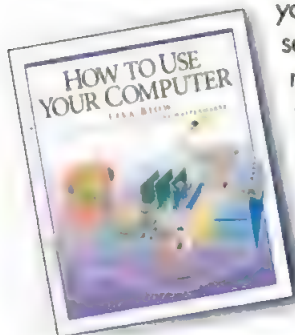
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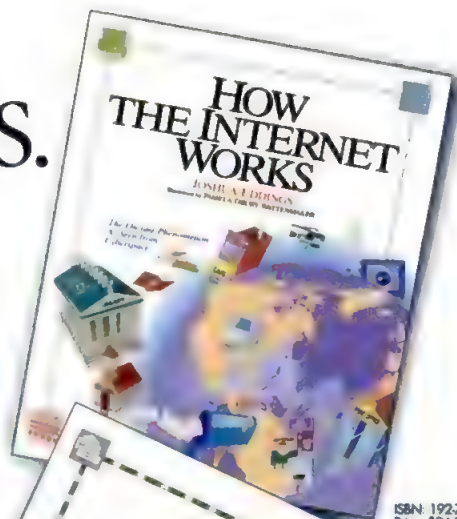
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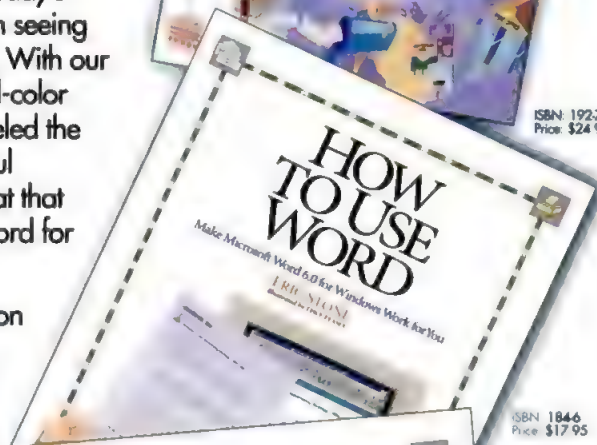
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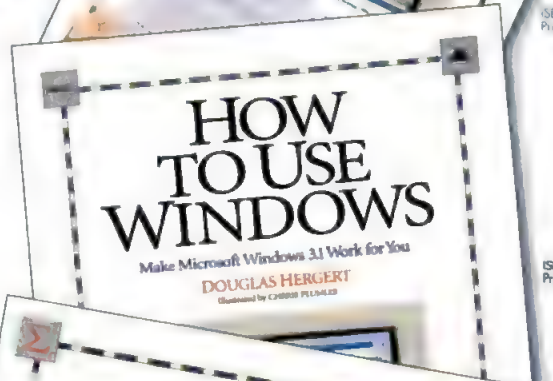
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Have Your Computer Call Me in the Morning

Frank, in March we explicated and debated the possibilities of computer telephony technology. Now, two months later, we are seeing some of our ideas turn to reality. Dozens of computer telephony products were demonstrated at the Computer-Telephony Trade Show in February, just after we submitted our March columns. Here are some that I felt represented the hottest new ideas.

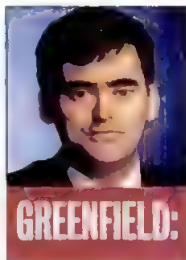
Softphones. There is a rage right now for software-controlled telephones. Many vendors offered products that implement both the controls and functions of a telephone through software. Many of these products offer conference calling, transferring calls, speed dialing, and other phone-related activities that are easily accessible through the point-and-click interface of Microsoft Windows.

Phone, fax, and e-mail integration. A sizable number of vendors showed phone-mail systems that integrate with fax and e-mail systems. Each has its own unique *modus operandi*. Phoneware, from Qsys (513-745-8070), for example, allows you to view a list of your pending voice-mail messages from your e-mail application's in-box. Repartee, from Active Voice (206-441-4700), allows you to view a list of your pending voice-mail and fax-mail messages, but you need to launch it first from your e-mail's in-box. Repartee also allows you to listen to your messages in any order you choose, allowing you to prioritize your calls. You can also set greetings with any of a number of customized messages, such as one that informs your caller about how much longer you expect to be on the phone.

Workflow for Voice Mail. Phonetastic, from SoftTalk (201-871-4646), lets a network administrator or user establish rules for how incoming telephone calls should be routed. Clients, for example, can be automatically routed to their respective salespeople, no matter where within the organization they may place their calls.

Many of these products will ship in June or July. Some of them will be available by the time you read this column. Just which of these products you'll be able to use, though, depends on a number of factors.

Frank, do these products hail a technological breakthrough or simply make us more dependent on phone vendors?



Many of these products
will ship in June or July.
Some of them will be
available by the time you
read this column.

It's all part of convergence, Dave. The *voice-data hype-way* (to steal a phrase from Interop's Dan Lynch) is a limited view of the convergence of voice, data, and video on the desktop. The evolving telephony stuff you saw is the I/O path for convergence. Without the right I/O, we'll never get at the information coming over the ISDN, cable, and satellite connections. The folks you saw are all moving in the right direction.

It's interesting to see AT&T acting very aggressively to get squarely astride the I/O channel that will deliver information to our eyes and ears. It is delivering PBX-control applications running as NLMs on NetWare servers under the NetWare Telephony Services. AT&T and Lotus jointly announced plans to put Lotus Notes servers inside AT&T's commercial network. Notes will become a public subscriber service. And AT&T and



If the industry is going
to press ahead, it must
develop standard APIs
or software shims for
voice-mail systems.

Microsoft are negotiating development of a wide range of services and products. Our telephone mama is surfing the info-wave!

AT&T's release of a NetWare version of its PassageWay software is a real diamond in the rough. You might mistake it for a set of PBX-management utilities as I did. But its major value is as an interface between incoming calls and database programs. PassageWay works with high-end AT&T Definity switches and with smaller AT&T Merlin switches too, so there is a big installed base of PassageWay-ready systems. If you're a VAR or developer, AT&T has just laid out a super way for you to play in the convergence game.

All those great packages you mentioned for voice-mail integration work only with specific voice-mail systems, so you're locked into one vendor and a limited selection of products. That's not what the PC and convergence are about.

Among the trumpeting elephants, there's still plenty of room for sly foxes. In the world of convergence, I want my PC to be the place where I do everything. If the industry is really going to press ahead, some team of sly foxes must develop standard APIs or perhaps software shims for voice-mail systems. All of the available information must come together in the same way to allow the PC to sort voice-mail messages effectively. Somebody has to do all the translating between proprietary voice-mail schemes and a standard interface. Convergence is a rich way to get rich.

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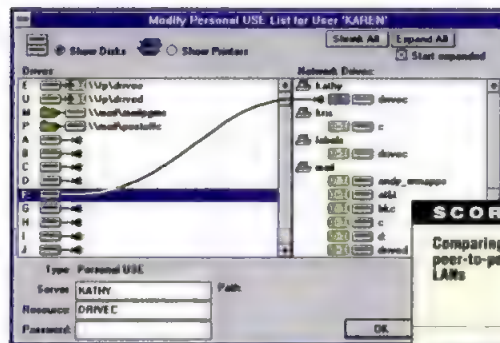
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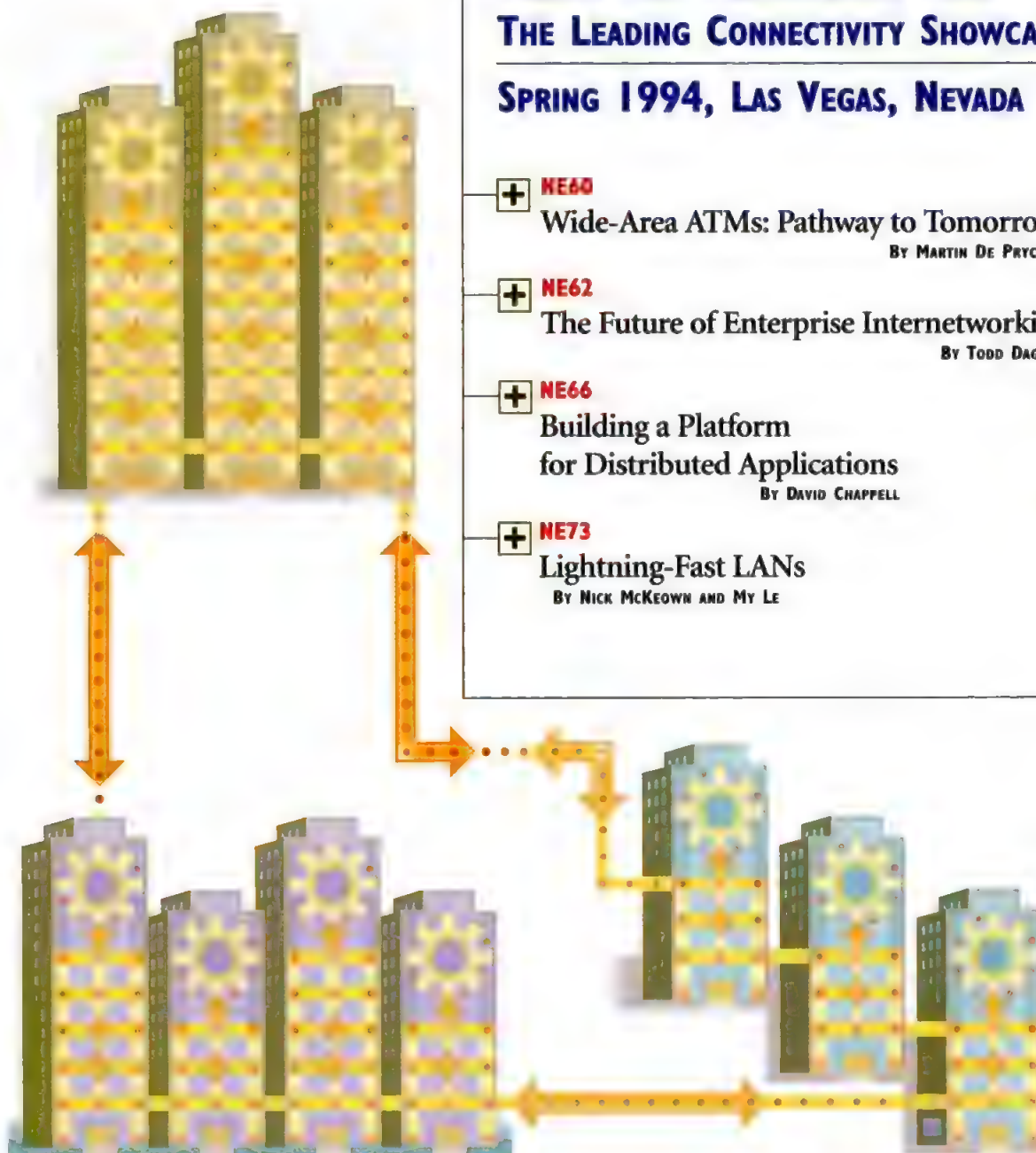
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Wide-Area ATMs: Pathway to Tomorrow

BY MARTIN DE PRYCKER

Until recently, the search for a unified wide-area network technology capable of handling voice, video, and data has stumbled on the technical difficulties of combining different types of traffic on the same network. Traditionally, each kind of communication has had its own tailor-made network. But with the advent of asynchronous transfer mode (ATM) technology, voice, video, and data will soon run on one single wide-area network.

Currently, high-bandwidth applications, like remote videoconferencing, multimedia, and CAD/CAM drive ATM deployment. Telcos—meaning PTTs abroad and long-distance and regional carriers here—implement asynchronous transfer mode as a single unified infrastructure acts as the foundation for a broad range of communications services.

ATM should provide several benefits to telcos and potential users alike. A unified network would be flexible, allowing telcos to integrate many of today's disparate and seemingly competitive technologies—including SMDS, FDDI, and frame relay—into a tightly knit bundle of services. Telcos could offer videoconferencing, and support for CAD/CAM and imaging, as needed. A unified network would also be cost- and bandwidth-efficient, meaning telcos could offer more services to more users more cheaply. Users could purchase only the services they wanted, at prices they could afford. And a unified network architecture would be the development platform of future—and futuristic—applications you can't even imagine today.

◆ The Advantages of ATM

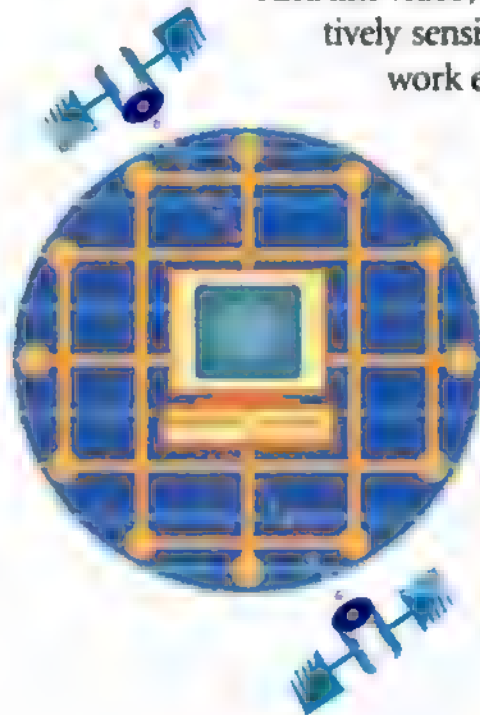
ATM is basically a cell-switching technology that operates at extremely high data rates: up to 622 Mbps currently, but potential data rates could reach Gbps. ATM runs on an optical fiber network that uses Synchronous Optical Network (SONET) protocols for moving data between ATM switches.

ATM was developed to solve the critical data communications problem of building a wide-area network that carries a range of radically different services. Voice, video, data, and

image communications all diverge dramatically in terms of optimal data rate, burstiness, and the delay and error rates they can tolerate. Voice traffic uses little bandwidth (64 Kbps or less) but tolerates minimal delay. Similarly, digital video is sensitive to delay, but requires great amounts of bandwidth (1.5 to 9 Mbps, depending on coding algorithms and format). High-resolution digital television eats even more (tens of Mbps). By contrast, data traffic tends to be bursty, which means bandwidth requirements can vary dramatically over time.

And like video, data is relatively sensitive to network error rates.

Today's



One ATM advantage is support of voice, video, and data transmissions under a single, unified network structure.

tures. First, all data moves across the network in fixed-length packets, or cells, which are 53 bytes long (counting the header information). Second, the use of smaller headers for each cell streamlines switching. Third, ATM provides error correction and flow control on an end-to-end, rather than a link-by-link, basis. Finally, ATM sets up virtual circuits between source and destination.

Each ATM feature was chosen for a reason. Short cells with smaller headers are the best possible compromise between delay and efficiency. Why? Shorter cells can be switched with low delay but are less efficient (header information makes up a higher percentage of traffic). Longer cells use bandwidth more efficiently (less header information compared to the data), but they take longer to switch.

By using short cells with simplified header information, ATM switches cells more quickly and keeps extra, bandwidth-eating information to a minimum. Smaller headers also enable relatively simple—and therefore faster—devices to do asynchronous transfer mode switching. End-to-end error correction and flow control cut down on delay through the network; the time required to perform link-by-link error checks is a major source of delay in packet networks such as X.25. Virtual circuits allow ATM to handle voice and video traffic, which typically requires a connection between the source and the destination.

◆ Implementing ATM

Architecturally, a wide-area ATM network is fairly simple. A telco constructs a network of ATM switches linked by SONET connections of 155 or 622 Mbps. To connect subscribers,

wide-area networks are highly specialized, with each type of traffic traveling on its own kind of network. Voice operates on a circuit-switched network that is mostly digital, except for the local loop. Videoconferencing runs over higher-speed, all-digital lines, while commercial television services arrive via cable. Data travels either on packet networks (X.25, frame relay) or over leased lines (T1, ISDN).

ATM handles all this traffic on one network. To provide each type of traffic with the service it requires, ATM relies on four key fea-

telcos use a variety of techniques, depending on the specific services used. For corporate and consumer digital video, they connect some type of video server to the ATM network. Then multiplexers/demultiplexers divide the high bandwidths of the asynchronous transfer mode network into smaller chunks suitable for digital video.

The "local loop"—the link between the mux/demux and the subscriber—consists of copper twisted-pair or coaxial cabling. Twisted-pair cabling is the cheapest of the two

alternatives. Using a technique called asynchronous digital subscriber loop, twisted-pair cabling supports about 6 Mbps in one direction, with a limited bandwidth (a couple of thousand Kbps) in the other. This scheme is ideal for dial-up video on demand, since customers send only short video request messages to the server and don't need fully bidirectional connections. For higher bandwidth applications, telcos will run fiber.

The ideal asynchronous transfer mode interconnection device at the user premises would be modular. It would be a bus-based device into which users would install network interfaces for optical fiber, coax, or copper twisted-pair cabling. On the line side, these interface cards would support video, narrowband ISDN, Ethernet, frame relay, or even other ATM devices.

ATM subscribers could configure their devices to match the services they ordered. A residential customer might choose the low-cost twisted-pair connection and a video output; a local-area network manager would pick fiber or coaxial cabling on the wide-area side, with Ethernet or frame relay interfaces to connect to routers and LANs.

◆ ATM Versus the Alternatives

How does ATM compare with other wide-area technologies? The short answer is that in most cases they're compatible, not competitive. Several schemes touted as competitors to ATM prove to be complementary on close analysis. In particular, switched multimegabit data services (SMDS), fiber distributed data interface (FDDI), and frame relay can coexist with ATM.

SMDS was developed by Bellcore as a way to transport high-speed data over long distances. Key points to remember about SMDS: It is a connectionless service, meaning it doesn't set up a connection between source and destination; it uses the same 53-byte cells that ATM does; and it operates at speeds of up to 34 Mbps. Its high data rates and connectionless operation make SMDS a good fit for transporting LAN traffic, which is bursty and bandwidth-hungry, but not delay-sensitive. SMDS is not a good fit for voice or video. Several U.S. carriers offer SMDS.

Because SMDS is not a technology but a service, and it uses the basic structures that ATM does, it's possible to implement SMDS over ATM. Indeed, that's probably how it will work in the future.

FDDI is a token-passing scheme that operates at 100 Mbps over optical fiber. An FDDI network is constructed in a dual ring topology (where one ring acts as the backup for the other). Although it can be used as a metropolitan-area network, FDDI has a built-in geographical limitation: the diameter of the FDDI ring can't exceed 100 kilometers. Practically speaking, this limits FDDI to local-area network or campus environments, where it might compete with ATM (see the sidebar, "ATM Serves Local-Area Networks Too"). But for the wide area, the most likely scenario is an FDDI LAN connection to an ATM WAN.

Frame relay is a form of packet switching that's halfway between conventional packet switching and asynchronous transfer mode. Like conventional packet-switching schemes such as X.25, frame relay uses variable-length packets; like ATM, it calls for a streamlined protocol for delivering those packets.

Although both technologies operate in the wide area, frame relay and ATM don't really compete: frame relay is much slower. It operates at rates up to T1 (E1 overseas), which is the lowest speed at which ATM can be effec-

tive. And it doesn't carry voice or video. Several carriers are constructing networks with both ATM and frame relay switches, so they can offer whichever service best fits their customers' needs.

◆ The State of ATM

Despite all the talk, ATM isn't yet widely deployed, although momentum is growing quickly. A sticky part of the issue is standards: some important details still need to be worked out before the technology can be widely adopted. In particular, matters such as congestion control and traffic management have yet to be thrashed out. The good news is that the standards work is progressing.

While it does, ATM trials and testbeds have been set up around the world, and in the U.S. alone several major telcos either offer ATM service or plan to offer it within the year. In all likelihood, these developments will lead to new ATM applications, further driving its implementation by communications companies. That means it's a sure bet that asynchronous transfer mode will soon affect the way we all do business.

Martin De Prycker is manager of Alcatel Bell's Research Center and the author of Asynchronous Transfer Mode: Solution for B-ISDN.

ATM SERVES LOCAL-AREA NETWORKS TOO

Asynchronous transfer mode was originally developed to be a wide-area networking technology, but users are first implementing it for LANs. ATM fits the LAN environment for several reasons. A requirement for high bandwidth is number one. Applications like CAD/CAM and plain old file transfers can bring conventional LAN technologies, such as Ethernet (10 Mbps) and Token Ring (4 or 16 Mbps) to their knees. ATM offers at least fifteen times the bandwidth of these older network access methods. Even FDDI has the drawback of sharing its 100 Mbps among all the users on the LAN, so the more users there are, the lower the bandwidth for each.

LAN traffic is also easier to handle than the wide-area variety, because the routing is easier. That makes it less difficult for vendors to design and build LAN ATM switches and interfaces, as opposed to WAN ATM gear. The fact that LAN traffic is now mostly bursty (unlike voice and video) also makes LAN ATM design simpler.

Furthermore, standards and compatibility issues aren't as critical for private networks as they are for public ones. LAN users don't know or care whether the adapter cards in their computers will work with ATM switches from other vendors, but if a telco can't get its ATM switches to interoperate, there's big trouble.

It takes a slightly different mindset to build and tweak ATM LANs. ATM is essentially a switching technology, more akin to the telephone network than the local data network. Still, data communications experts will quickly adapt, with the help of telcos and other providers.

Indeed, vendors of ATM LAN gear already sell switches and adapter cards to construct ATM-based LANs. Companies can also use ATM as a backbone interconnecting technology to interconnect routers. In this scenario, Ethernet and Token-Ring LANs connect to routers, which funnel the traffic over a high-speed ATM backbone to other routers and LANs.

— MDP

The Future of Enterprise Internetworking

By TODD DAGRES

Several major trends are shaping the future of enterprise internetworking. Most are being driven by new multimedia applications, faster processors, and distributed client/server computing. All aim at higher performance and greater network predictability.

◆ Switching to Switched LANs

The migration from traditional shared media local-area networks to switched media networking is one of the dominant trends in today's internetworking market. By applying principles developed in the telephone industry, new switched-media LANs are providing higher performance and more predictable operation than traditional LANs. This is changing the way people think about internetworking.

With the transition to switched LANs, the distinction between internetworking devices (routers) and hubs will blur. Local-area networks will resemble today's wide-area packet-switched networks and follow a switching hierarchy. Departmental LAN hubs will incorporate switching through high-speed backplanes and switching modules. These hubs will be connected to LAN backbones consisting of high-speed routers. Asynchronous transfer mode (ATM) switches will comprise the wide-area backbone, with

acquisition and its IBM relationship; 3COM, with its acquisitions of BICC, Star Tek, and Synernetics to go with its router product line; Cisco, with its Crescendo acquisition and recent workgroup switch introduction; Wellfleet, with its Alantec alliance; Network Systems, with its Bytex acquisition; Ungermann Bass, with its Dragon Switch; SMC, and its ES1 Switch; and Grand Junction, with its \$250-per-port Ethernet switch.

◆ New Plumbing

The development of faster LAN technologies, including Fast Ethernet, FDDI over copper, and ATM, is another trend that will alter internetworking.

Although the migration to 100 Mbps at the

mance characteristics of internetworking devices, since traffic speeds will jump 10 to 15 times. Internetworking devices will require higher performance processors, buses, and interfaces to cope with the higher LAN speeds. Vendors will be driven to multiprocessor and parallel-processor architecture, especially as demand for high-speed local-area networks ramps up.

ATM will begin to dominate facility networks and LAN backbones as time goes on. Its speeds will make all other internetworking devices, and many local hubs, redundant. ATM switches will gradually replace the routers that currently constitute many LAN backbones. Greater performance and the proliferation of multimedia applications will result.

Several companies have announced ATM intentions. Wellfleet will offer a pure ATM switch while Cisco is selling ATM interfaces to its routers. Both approaches will produce high-speed switching, but Wellfleet now seems more committed to building a pure cell switch. Fore Systems, Newbridge Networks, NET, and SynOptics also offer viable approaches to ATM internetworking, but keep an eye out for Agile Networks—a newcomer in ATM LANs.

◆ Remote But Connected

Because nomadic employees and telecommuters require the same access to routers as do people in the office, remote network access is becoming a key component of the enterprise internetwork.

Dataquest estimates there are 15 million workers spending over 50 percent of their time outside the office this year. By 1995 there will be 10 million laptop computers in the U.S., 50 percent of them equipped with modems. The number of workers telecommuting regularly in the U.S. will rise from 3 million people last year to 10 million people in 1996, according to the Yankee Group.

A host of vendors are converging on the remote internetwork access market. Telebit,

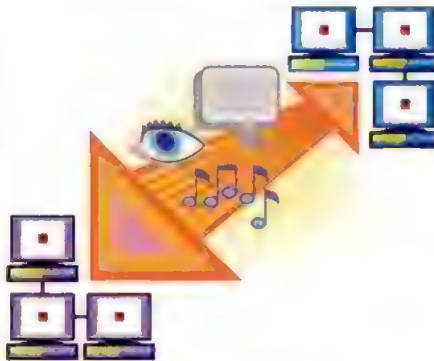
Multimedia programs, faster processors, and distributed applications drive the move to enterprise networks.

routers acting as the on and off ramps.

Recent acquisitions bringing together hub and router vendors suggest the power of the switched-LAN trend. The leaders in local-area network switching will be a cross section of internetworking and hub vendors as well as some new niche players. These include Cabletron, with its "do-it-yourself" approach; SynOptics, with its Coral Acquisition and ATM investments; Chipcom, with its Artel

desktop will be gradual, internetworking users will be the first to adopt the higher data transfer speeds. A recent Gartner Group survey found that 47 percent of 200 large firms surveyed planned to install new cabling within three years. The study also found that 17 percent of respondents planned to invest in the 100 Mbps to the desktop within the next 12 to 18 months.

These new technologies tax the perfor-





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Centrum (3COM), Shiva, Livingston, U.S. Robotics, Xylogics, Caymen Systems, and DCA/Citrix approach from the modem and communications server market with strengths in dial-up networking and modem pooling. Cisco, ACC, NEC America, Microcom, Rockwell, and Wellfleet approach from the router market, adding dial-up capabilities to their products.

Teleos, Ascend, and Primary Access are addressing remote access from the inverse mux market, offering higher-speed network access for switched digital and ISDN. Remote-control software vendors such as DCA, Microcom, Symantec, and Norton-Lambert offer access to local resources without routing. Other vendors, including Xcellent and DigiBoard, have their own unique approaches.

Wireless modems and servers are another option for the remote user. Service providers such as Ardis, RAM Mobile Data, and McCaw/AT&T pitch their wares as a means of internetworking the nomadic worker.

◆ Strengthening the Backbone

Today the enterprise internetwork consists of a multistar topology, with routers connected by T1 lines. This paradigm will change in the next several years to accommodate higher speeds and more cost-effective bandwidth usage. The dawn of the 1,000-router network and the advent of imaging and multimedia traffic will force an upgrade of the internetwork backbone.

A model for the future internetwork is the PSI network, the largest independent internetwork access provider in the U.S. To keep up with customer demand and manage the cost of bandwidth, PSI is in the process of upgrading its backbone network. The first phase of the migration will use Cisco routers and Cascade switches to form a frame-relay backbone; the next phase will upgrade from frame relay to ATM switches in the core of the network. Gradually, the ATM core will expand.

In the middle of this migration to high-speed internetwork backbones will be Cisco and Wellfleet, preeminent router vendors now moving into the ATM business. Both are committed to pushing the performance envelope in terms of throughput and port density. Cascade, Stratacom, Newbridge and NET will also offer products for the internetwork backbone. Using a combination of frame relay and asynchronous transfer mode switching, these vendors will provide the next generation of backbone data switches. Routers and switches will coexist as the former provide connection management and protocol support and the latter deliver high-speed pipes.

◆ The Virtual Reality of Public Services

Internetworking services are catching fire. The frame relay market, after 2 years of meandering, has taken off in the last 6 months. In general, frame-relay public virtual circuits (PVCs) are less expensive than comparable leased lines, depending on distance. Frame-relay PVCs are growing at a rate of 20 percent per month, according to the carriers.

SNA is still the dominant data communications architecture in most companies. A Forester Research study estimated that 88 percent of branch offices were networked via SNA in 1993. Frame relay enables the combination of SNA and LAN traffic in the same frame-relay PVC. Advances in encapsulation, prioritization, and routing algorithms have improved the class of service characteristics of frame relay for SNA traffic. NetLink, Sync Research, ACC, and Hypercomm have developed robust frame-relay internetworking solutions.

Sprint, Infonet, PSInet, Alternet, and others have had success with IP routing services and now the rest of the carriers, including MCI and AT&T, are jumping on the bandwagon.

New ATM services from Sprint, MFS, AT&T, and Wiltel are also available for high-speed LAN interconnection.

With public internetworking services, users need not deploy private network facilities. Carriers will provide internetworking devices, network operations, and even naming and addressing services. The carrier is the access, the backbone, or both. The result is a "virtual" internetwork operated by the carrier.

◆ Controlling the Monster

Enterprise internetworks are getting bigger, more complex, and more difficult for managers to control. Internetworks are, by definition, *multiprotocol*—meaning that each protocol on the network has its own unique requirements. According to a 1993 Yankee Group study, the average Fortune 1000 internetwork carries four protocols with TCP/IP, IPX, DECnet, AppleTalk, and NetBIOS being most common.

TCP/IP is emerging as a unifying internetwork protocol standard. This is good news and bad news. The good news is one protocol may now have support across the majority of computing platforms. The bad news is now you have to hire a VP of IP addressing.

Any internetwork user understands the management challenge presented by a multiprotocol environment. To cope with the challenge of thousands of users, thousands of circuits (whether permanent or virtual), hundreds of internetworking devices, and dozens of unique applications, a rock-solid management approach is required.

The future internetworking management system will include a network management platform, a set of applications from both internetwork vendors as well as application developers, distributed management processors, and remote management probes and monitors integrated into the various internetworking devices.

HP, Sun/Netlabs, and IBM offer the best management platforms. Internetwork vendors such as Cisco, Wellfleet, Cabletron, SynOptics, 3COM, and others offer applications to manage their products. Third-party developers such as Networx, FTP Software, ISIsoft, and Remedy also offer applications. Wandell & Goltermann, Network General, and others offer distributed management systems to monitor each LAN or network segment. In addition, internetwork vendors are building management agents into their

products to enable remote management via SNMP and RMON. The key to internetwork management will be distributed management resources controlled with centralized management intelligence.

◆ Multimedia Soon

Although the desire for multimedia applications is driving improvements in internetworking performance and predictability, these improvements are themselves spurring the development of new multimedia applications. At the moment, image, voice, and video can be routed across an internetwork, but real-time multimedia, including videoconferencing, simulation, and 3D modeling is another story. This traffic requires bandwidth and predictability current internetworks can't provide.

The trends, however, indicate it won't be long. Switched-media LANs, better backbones, faster LANs, and better network management will soon make high-speed, multimedia internetworking a reality.

Todd Dagres is a securities analyst and vice president with investment bankers Robinson-Humphrey of Atlanta, GA; he is also a frequent writer and lecturer on enterprise internetworking technology.

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Building a Platform for Distributed Applications

By DAVID CHAPPELL

You can build distributed applications in a vacuum, just as you can write single-machine applications without an operating system. It makes more sense, though, to build distributed applications on an infrastructure, something that provides the basic services needed for distribution.

Among the most visible platforms for distributed applications are the Open Software Foundation's Distributed Computing Environment (DCE) and the Common Object Request Broker Architecture (CORBA), developed by the Object Management Group. While these are vendor-neutral platforms offered by several companies, many vendors promote proprietary approaches, with Novell's AppWare currently heading the visibility list. Visibility and viability are different things, however, something that becomes obvious with a closer look at the choices.

◆ OSF DCE: Leading the Pack

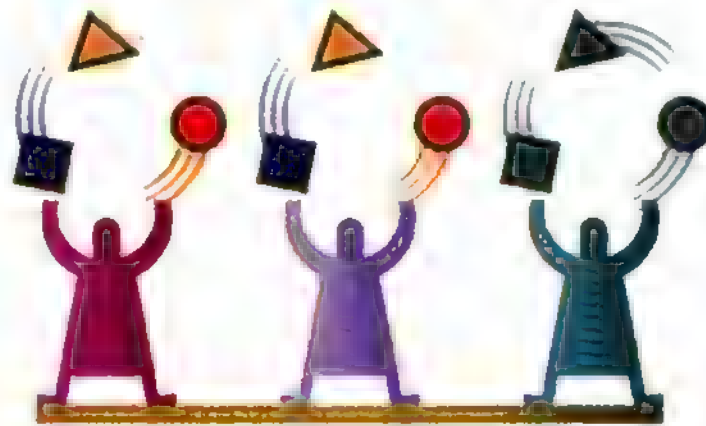
The Open Software Foundation (OSF) was founded as a consortium by IBM, Hewlett-Packard, and Digital Equipment Corp. Most of the industry and many large users eventually joined, making OSF a significant player. As its name implies, OSF offers software, general-

DCE should one day become a widely used platform for client/server applications.

◆ From Clients to Servers: RPC

To work effectively, client/server applications require several services, including a way for the client and server to communicate, clients to locate servers, and a mechanism to ensure secure interaction between clients and servers. DCE provides these services and more.

The fundamental mechanism in DCE for clients to talk to servers is remote procedure call (RPC). RPC is a simple idea—take the familiar notion of a procedure call and distribute it. The client invokes what appears to be an ordinary procedure (also known as a function or subroutine), complete with parameters. The called procedure's body, however, is in



For distributed platforms, visibility and viability are two different things.

ly from a merger of existing products, then licenses that software to all comers.

OSF DCE is a strong product. Supported today by virtually every major system vendor, many DCE pilots are well under way, and some organizations have begun production use. Versions for Microsoft Windows are widely available, and part of DCE is shipped by Microsoft with Windows NT, with more to be added soon. In fact, Microsoft's distributed version of its Object Linking and Embedding (OLE) technology operates, in part, over DCE.

While too soon to declare it a sure winner,

another process: the server. The request and parameters are conveyed to the server, execution of the procedure takes place, and results (if any) are returned. To the caller, the process looks and behaves like an ordinary local call.

This familiarity is one of the benefits of RPC. It's important to understand, though, that an RPC mechanism just provides support for client/server interactions—the content of those interactions is defined by the developer of the RPC-based application.

DCE RPC provides only the tools that support this model of distributed interaction,

including the Interface Definition Language (IDL), used for defining the interface between clients and servers; the IDL compiler, a tool that reads IDL definitions and generates code, called "stubs," to carry out the mechanics of performing the remote call; and a protocol to convey client/server requests and responses.

One major problem with RPC is that the caller must block (or pause) while waiting for a response from the server, which is inefficient. To avoid this problem, all DCE implementations incorporate threads. Threads allow a single process to contain multiple, apparently simultaneous flows of control. When a thread makes an RPC, that thread blocks until the response comes back, but other threads in the process are free to execute. The addition of threads to DCE eliminates what most see as the single greatest objection to RPC.

◆ Directory and Security Services

To help clients find servers, DCE provides a directory. When it starts, servers do something called "exporting binding information," storing in the directory all the information required to contact it. A client that knows a server's name can then "import" this information from the directory and begin making RPCs to the server. If the chosen server fails, the client can return to the directory and look for another server offering the same service.

DCE security services include:

- ◆ authentication, where clients prove to servers that they are who they say they are;
- ◆ authorization, where the server decides exactly what a client can do;
- ◆ data integrity, where clients and servers guard against undetected modification of data during transit; and
- ◆ data privacy, where clients and servers exchange information that can't be read by prying eyes.

◆ DCE's Dark Side: Management

There are a few dark spots in this otherwise bright picture of DCE. For one, DCE is not simple to set up and install, nor is it particularly cheap. And the learning curve for applica-



tion developers and administrators is steep.

Perhaps the biggest problem with DCE is management. A DCE environment provides a number of services to distributed applications, but all these services require initial setup and ongoing administration. Most observers believe the current set of DCE management tools is inadequate. Vendors have begun to improve the situation, and OSF's next DCE release will also provide better tools. Still, managing a DCE environment will remain challenging for the foreseeable future.

◆ CORBA: Adding Objects

There's nothing explicitly object-oriented about DCE. Designed before the current yen for objects, the OSF targeted DCE at traditional procedural applications. The OMG, however, targeted its CORBA at supporting object-oriented distributed applications, and many vendors offer CORBA products.

Like OSF, OMG is a consortium of vendors and users. Unlike OSF, OMG produces only paper specifications, not actual software. Vendors are free to implement these specifications as they see fit, and have produced a remarkable variety of CORBA-based products.

CORBA is quite similar to DCE: It, too,

provides an infrastructure for supporting distributed applications. And like DCE, CORBA defines a Language (IDL) for specifying the interface between clients and servers. To a programmer, using CORBA can be much like using DCE in that one invokes "operations" on remote "objects" in much the same way a DCE client invokes remote procedures in some servers. The CORBA IDL compiler will even generate stubs to support these requests.

CORBA has other useful features, too. It defines a standard interface to a truly object-oriented language, C++—something lacking in the DCE world. Along with the RPC-like interface described above, CORBA supports a dynamic approach in which a client can learn about new server objects while running and invoke operations on them. This approach even provides a nonblocking option, allowing a client to make a request, then check for a response later. All this was designed with the principles and practices of object-oriented technology in mind.

◆ Concerns with CORBA

What more could users want than a widely supported standard for distributed object computing? As it stands today, quite a bit.

CORBA's appearance is greater than its substance, with weak interoperability being chief among its problems. The current version defines no standard for how products from different vendors can work together; for the most part, then, they don't interoperate at all.

How could a standard for distributed computing fail to define interoperability? The answer lies in the consensus-oriented process used to create CORBA. Since the major vendors involved in the process took very different approaches in building CORBA-based products, they failed to agree on how those products would work together.

If not interoperability, then what about *portability*, the other expectation one has from standards? CORBA has more to offer here, but still it falls short of what users might wish for. It does define a number of standard interfaces that provide some application portability, but CORBA also omits much. Some of the interfaces it does define are so sketchy that vendors must add extensions before applications can use them. This may increase functionality offered, but it decreases application portability.

◆ Which Platform?

Using a single infrastructure for distributing applications makes sense—but which one, CORBA or DCE? The looming specter of Microsoft's Distributed Object Linking and Embedding (OLE) further complicates this decision. OLE serves many purposes—providing a way to embed one kind of object in another, acting as a mechanism for supporting drag-and-drop, and more—but all rely in the end on OLE's Component Object Model. Similar in many ways to CORBA, it also has a clearly defined protocol for remote interaction. DEC already has agreed to support remote OLE objects on its platforms, and agreements with other vendors are likely. With interoperability, true portability, and the Microsoft imprimatur, Distributed Object Linking and Embedding is undeniably attractive. If you can't have standards, Microsoft is the next best thing.

Despite Microsoft's market dominance, for the multivendor world inhabited by most organizations, OSF DCE looks like a good choice. It provides the right services, has widespread support, and despite some management headaches, offers tangible benefits.

David Chappell is the principal of Chappell & Associates, a training and consulting firm specializing in distributed computing. He is a consultant to OSF for both DCE and DME, and is also a member of OMG.

NOVELL'S DISTRIBUTED SOLUTION

AppWare is Novell's platform for distributed computing. It's intended to simplify the development of network-based, distributed applications. Novell is not the only company offering such a platform, but given the company's dominance in the networking market, AppWare may have an edge.

The platform has two major components: AppWare Foundation (AF) and AppWare Bus (AB). AF provides a cross-platform set of APIs that hide the complexities of heterogeneous operating systems, GUIs, and network services from the developer. According to Novell, applications written with these APIs are just as fast and powerful as those written with native-platform APIs.

AppWare Bus is something akin to a software backplane into which developers can slot prewritten objects from a variety of libraries. These pluggable software modules, called AppWare Loadable Modules (ALMs), can range from the simplistic to the complex. Novell will provide basic ALMs with AppWare, and has promised an OLE ALM to allow AppWare applica-

tions to use OLE-based plug-ins.

The AppWare Bus allows ALMs to communicate and work together through an event engine. The AB compiles linked ALMs into an executable—the finished application. The benefit is cross-platform solutions with reduced time and effort, and increased functionality.

Novell's Visual AppBuilder speeds development with a graphical "drag and link" environment for connecting objects and functions. Select the objects you require from a palette and draw a connection. VA checks to make sure the function chain is valid, and then generates the code. Sure, there are other visual application builders, but this one rapidly creates network applications that can run on heterogeneous platforms—not a trivial task.

As with other object-oriented development platforms, users will have to consider the interoperability of AppWare. Some in the industry hope to use the OMG's CORBA as a starting point for interoperability, but chasms can persist between specifications and implementations.

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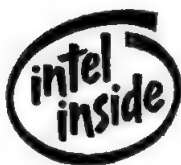
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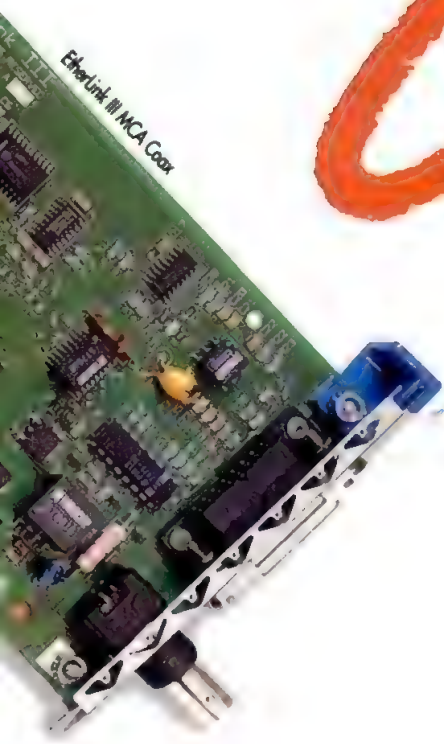
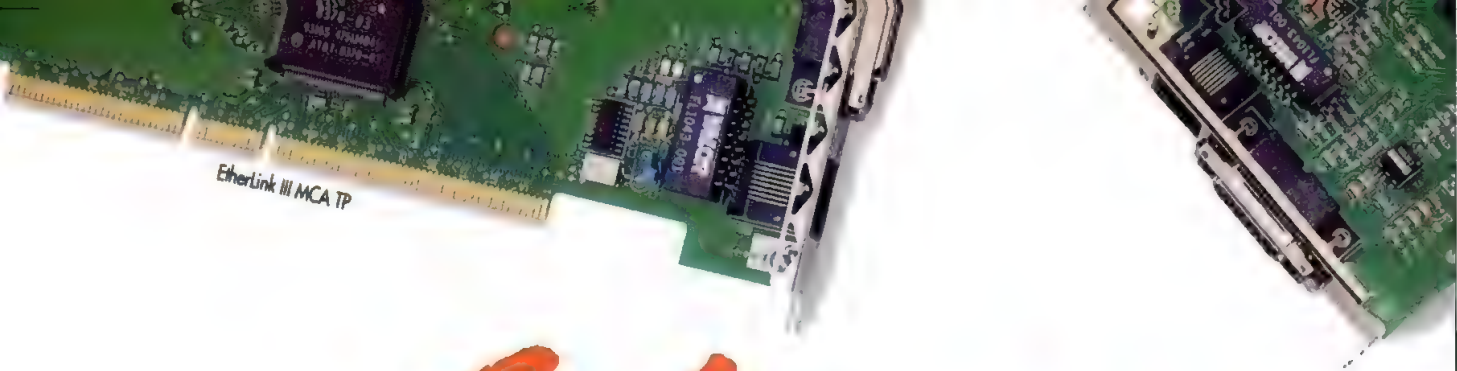


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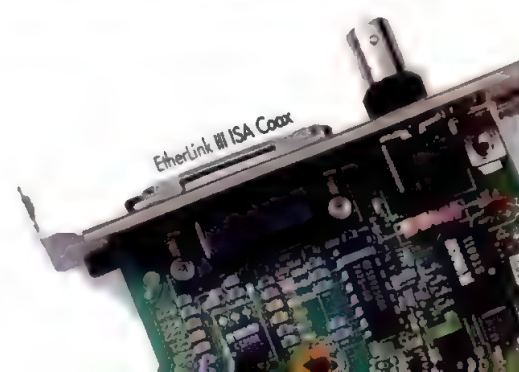
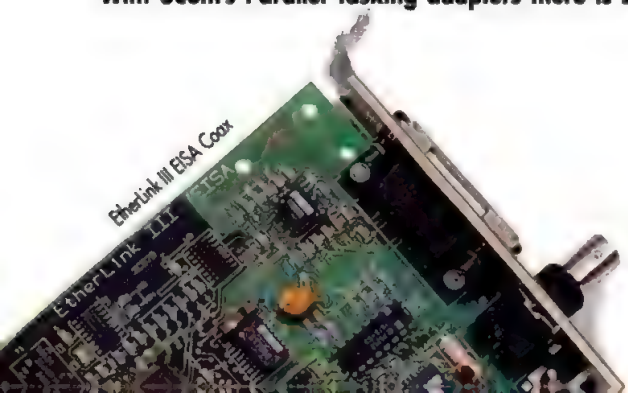
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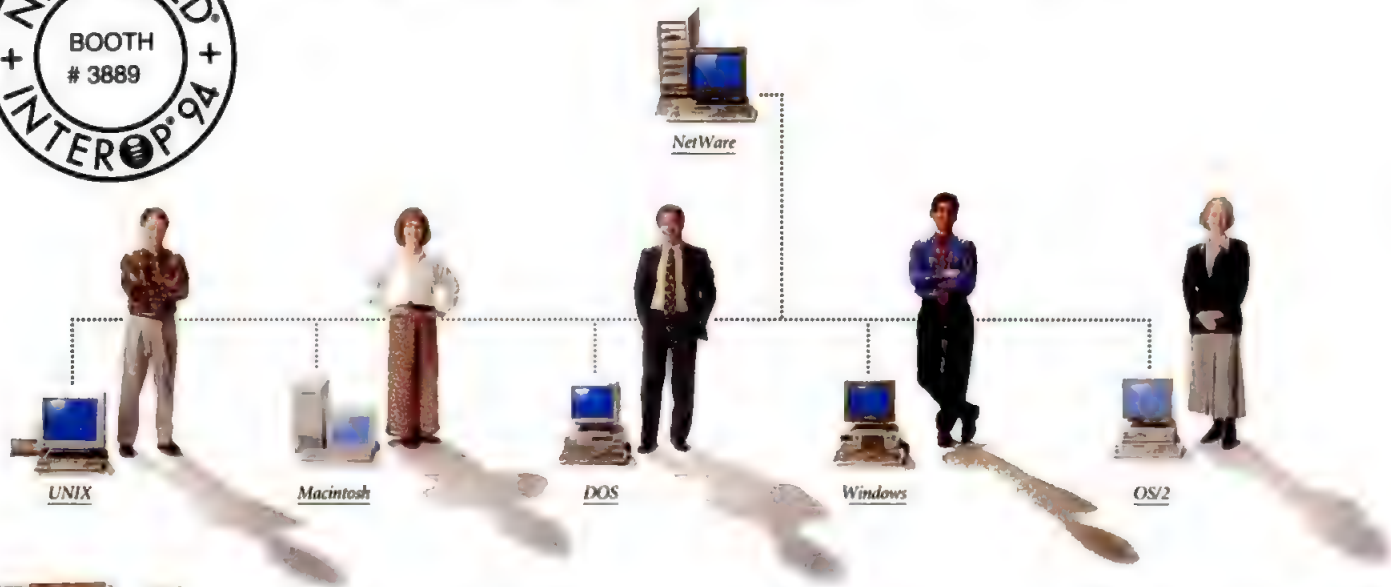
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Lightning-Fast LANs

By Nick McKeown and My Le

Managers of 10-Mbps Ethernet LANs face a constant struggle to overcome the congestion caused by a rapidly growing number of users. They already resort to expensive solutions, including switched Ethernet hubs and network segmentation using bridges and routers. But even these solutions can't offer a single user more than 10 Mbps—not enough for the new multimedia applications proliferating on powerful Pentium and PowerPC platforms.

Quite possibly, a realistic and inexpensive alternative is emerging: 100-Mbps Ethernet. Two vendor groups are currently competing to build a 100-Mbps Ethernet standard. One is called 100BaseT (a subcommittee of IEEE 802.3); the other is called 100VG-AnyLAN (IEEE 802.12). On the face of it, these techniques are very similar: each builds on the experience and convenience of 10BaseT hub-based systems; both use existing Category 3, 4, or 5 unshielded twisted pair (UTP), shielded twisted pair (STP), or fiber cabling; and both maintain the same Ethernet packet format. Even more important, both will be competitively priced—as low as \$200 per connection.

Nevertheless, there are important differences between the two proposed standards, mainly vendors and media access method.

◆ 100BaseT

100BaseT, sponsored by 3Com, Grand Junction, Sun Microsystems, Intel, National Semiconductor, Standard Microsystems (SMC), and Synoptics uses the well known CSMA/CD media access control (MAC) protocol. The aim is to extend the life of Ethernet a few years until ATM arrives. Without changing the packet format, this can be achieved only by reducing the size of the 10BaseT network to a radius of less than 150 meters. Fortunately, according to AT&T, most networks have a radius of less than 100 meters.

100BaseT nets running over voice grade Category 3 UTP uses a technique called 4T+, supported by 3Com, AT&T, and others, requiring four pairs of wire up to 150 meters between an end station and its hub. Three pairs of wire transmit carefully coded data, while the fourth detects collisions. Although the majority of installed wiring is Category 3,

most new wiring is Category 5. For this kind of wiring, 100BaseT networks need only two pairs of wire and a technique called 100BaseX. This is based on Grand Junction's signaling technology (TP-PMD), designed for CDDI. To accommodate both 100BaseX and 4T+, the 100BaseT standard defines a Medium Independent Interface (MII) between the CSMA/CD protocol and the physical layer. This means that network adapter boards may be designed to work with both kinds of wiring, like the AUI interface in Ethernet.

◆ 100VG-AnyLAN

100VG-AnyLAN, sponsored by HP with backing from AT&T and IBM, uses a different approach. HP adopted a centrally controlled and deterministic access scheme, demand priority. This eliminates collisions and increases network efficiency. In addition, bandwidth-critical and delay-sensitive applications may request to send packets using two priorities. While using the same structure as 10BaseT and 100BaseT, 100VG-AnyLAN supports structures for both 802.3 Ethernet and 802.5 Token-Ring nets.

In a 100VG-AnyLAN network, end stations are connected to a hub which may in turn be connected to higher-level hubs up to a maximum of three levels. Each hub provides access to each requesting station in turn, using a round-robin schedule.

The IEEE 802.12 standard allows physical links of up to 100 meters of four-pair Category 3 UTP wire, 150 meters of two-pair Category 5 UTP or STP wire, and 2,000 meters of fiber-optic cable. In each case, packets are split into four separate channels that are then scrambled and encoded before being sent to the physical layer for transmission. Running over Category 3 UTP, two pairs of wire are used to signal requests to the hub and then all four pairs are used for data transmission and reception. When using two-pair Category 5 UTP, STP, or fiber, the four separate channels are multiplexed together.

◆ Network Upgrade Planning

So how does a network planner choose between upgrade paths? It is virtually impossible at this point to make a clear distinction, much less a recommendation, because neither standard is complete (though some vendors are shipping product). Comparisons on features like functionality, cost, and interoperability can be made only after vendors implement the standards.

Even when standards are complete, users and applications will see little or no difference between 100BaseT and 100VG-AnyLAN, mainly due to the common packet format used by each. Managers, too, will find little to choose from: both standards run over common wiring, and support current topologies and most common network sizes. Both are

also sure to provide similar data integrity and robustness.

Right now the differences between the two standards revolve around two issues: they are vendors and access methods. Vendors that are most involved in Token-Ring technology are backing 100VG-AnyLAN, with its deterministic,

demand-priority access; those familiar with Ethernet are behind 100BaseT. Given other similarities between the technologies, which vendor supports which technology probably means more than the technologies themselves.

Nick McKeown is a doctoral student in ATM switch design at UC Berkeley. Formerly at HP Labs in Bristol, England, he holds two patents in high-speed networking.

My Le is a consultant in high-speed networking and is in a Berkeley doctoral program in wireless communications. She served on the ANSI FDDI and IEEE 802.6 standards committees.

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926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950
951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975
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User-to-User

BY NEIL J. RUBENKING

Program Manager's Lazy Shortcut Keys

The Windows 3.1 Program Manager allows shortcut keys that quickly launch an application. To assign a shortcut key to a Program Manager icon, you click the icon to select it, and then choose Properties from the File menu. Select the shortcut-key box and press the shortcut-key combination you want. Valid key sequences are Ctrl-Alt-character, Ctrl-Shift-character, and Ctrl-Alt-Shift-character. However, pressing all three or four keys at once can challenge even the most experienced user. Fortunately, there's an undocumented alternative to this finger-twisting experience.

If you simply type a character, Program Manager selects the next icon whose description begins with that character, regardless of case. Once the desired icon is selected, press Enter to launch that application. For example, if you have icons for Calculator, Calendar, Cardfile, and Character Map, pressing C will cause Program Manager to select each of these in turn. Although not as quick as the true shortcut key sequence, this "lazy" method is much easier on the fingers.

Bennett Dear
Costa Mesa, California

Program group start with different letters. Otherwise, you have to look to see which one is highlighted before you press Enter. You'll at least want to arrange the icons so those that begin with the same letter are near each other. To control the order in which Program Manager cycles through same-letter items, just click on each of them in the reverse of the desired order. Note, though, that this order can change any time you click on one of the items.

You can't select Program Manager groups in the same way, even when all groups are minimized. However, you can cycle through all the groups by repeatedly pressing Ctrl-F6. When you want to cycle in the opposite order, just press Ctrl-Shift-F6.

If a program that has a regular Program Manager shortcut key happens to be running, pressing the shortcut key will activate that program. There's no way to duplicate this feature with lazy shortcut keys!

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► **PC MAGAZINE:** It's easiest to use the lazy technique when all of the items in a pro-

Processing a List of Files

Sometimes I make careless mistakes when using a command like XCOPY /S. I then have the tedious chore of walking through each of the directories created by XCOPY, deleting all the files in each and finally deleting the directories themselves. At times like these, I wish that I knew a way to create a file containing a file list with arguments inserted in appropriate places, ready to do multifile operations on all the files in the list.

Actually, the DIR command in DOS 5.0 and later has options that let you create a file list in a format appropriate for this kind of processing. You just need some kind of filter that takes the redirected output of DIR /B and puts it in a form like this:

```
%1 FILENAME.EXT %2 %3 %4 %5 %6 %7  
%8 %9
```

or this:

```
%1 %2 FILENAME.EXT %3 %4 %5 %6 %7  
%8 %9
```

I wrote a DEBUG script that creates both these filters. The program XFLT1.COM produces the first format (one argument before the filename). The program XFLT2.COM generates the second format (two arguments before the filename). Now just two commands will delete all files in and below a certain directory:

```
DIR directoryname /a:-d/b/s |  
XFLT1 > TEMP$$$$.BAT  
TEMP$$$$.BAT DEL
```

Two more commands will delete the directory and all of the empty subdirectories in it:

XFLT.SCR Complete Listing

```
N XFLT1.COM
A 100
JMP 0125 ; Jump over data
NOP
DB "1 ", 0, " 2"
DB " 3 4 5 6 7 8 9"
DB 0D 0A 00 00 00 00
MOV AX,CS ; Move CS to DS ...
MOV DS,AX ; ... via AX
MOV DI,0190 ; Point DI at buffer
; :ReadChar
MOV AH,3F ; Select "Read file or device" function
MOV BX,0000 ; Read from handle 0 (standard input)
MOV CX,0001 ; Read one byte
MOV DX,0122 ; Point DS:DX at data area
INT 21 ; Call DOS function
MOV [0123],AX ; Store result
MOV AL,[0122] ; Move character into AL
CMP AL,0A ; Is it line feed?
JZ 0159 ; If so, jump to :OutOfLoop
CMP AL,0D ; Is it carriage return?
JZ 012C ; If so, loop to ReadChar
CMP WORD PTR [0123],+00 ; 0 bytes read?
JZ 0159 ; If so, jump to :OutOfLoop
CMP DI,020E ; Buffer full?
JGE 0159 ; If so, jump to :OutOfLoop
MOV [DI],AL ; Move character into buffer
INC DI ; Read DI for next character
JMP 012C ; Loop back to ReadChar
; :OutOfLoop
MOV BYTE PTR [DI],00 ; Put final 00 into buffer
CMP WORD PTR [0123],+00 ; Exit because no more chars?
JZ 017C ; If so, jump to :Exit
MOV BX,0103 ; Point BX at stored string
```

```
CALL 0181 ; Call :Output
MOV BX,0190 ; Point BX at buffer
CALL 0181 ; Call :Output
MOV BX,0107 ; Point BX at rest of stored string
CALL 0181 ; Call :Output
CMP WORD PTR [0123],+00 ;
JNZ 0129 ;
; :Exit
MOV AX,4C00 ; Select Exit with return code function
INT 21 ; Call DOS function
; :Output
MOV AH,06 ; Select Direct console I/O function
MOV DL,[BX] ; Put char in DL
CMP DL,00 ; End of string?
JZ 010F ; If so, jump to Return
INT 21 ; Call DOS function
INC BX ; Ready to output next character
JMP 0103 ; Jump to :Output
; :Return
RET
F 190 28F 0
RCX
018F
W
NXFLT2.COM
A103
DB "1 2 ", 0
A16F
MOV BX,010A
W
Q
```



Figure 1: This DEBUG script produces two filter programs that make it easy to write batch programs that process lists of files.

```
DIR directoryname /a:d/b/s | SORT
/R | XFLT1 > TEMP$$$$.BAT
TEMP$$$$.BAT RD
```

Of course, there are many other ways to use these filters. I hope you'll find them useful.

Roman Lasenko
Tel Aviv, Israel

►PC MAGAZINE: Mr. Lasenko's original DEBUG script was nothing but a series of E (Enter) commands that built the two filter programs byte by byte, like so:

```
E 100 EB 23 90 25 31 20 25 32
```

Unfortunately, this kind of script conveys nothing at all about *how* the program works. I thought highly enough of the resulting programs that I rewrote the script in DEBUG-style assembler (shown in Figure 1). (I should let you know that if you're thinking of submitting a DEBUG script for this column, your chances of getting published are definitely better if you use the assembler style in the first place!) As usual, use the command `DEBUG < XFLT.SCR > XFLT.LOG` to create the COM programs. If the .LOG file shows any errors, correct the offending lines and try again.

DOS doesn't provide any built-in way to process a list of files, so batch programmers have had to devise their own methods. One style involves creating an ancillary data file containing the name of another batch file followed by a space and no carriage return. The main batch file repeatedly prefixes this file to the list of filenames, runs the resulting temporary batch file, and uses FIND to strip out the first line. Because of all the file manipulation required, this method is quite slow.

Another approach involves several peculiar twists. In preparation, you must copy the LOADFIX.COM program (present in DOS 5.0 and later) to the name ENTER.COM. The batch file redirects the file list as input to the DATE command and filters the result, yielding a file in which each line consists of "Enter new date (mm-dd-yy):" followed by a filename. Running the resulting file repeatedly executes a batch file or a program named NEW, passing as parameters date,

(mm-dd-yy):, and one of the filenames. This method requires less file manipulation than the previous method, but it's awkward. Compared with these earlier methods, the filter technique is a marvel of simplicity.

*DOS doesn't provide
any built-in way to
process a list of files, so
batch programmers
have had to devise their
own methods.*

The examples discussed above both use XFLT1.COM to process files using DOS functions. You'd use a similar technique to pass each filename to a program. If you want to pass the list of files to another batch file, however, you'll need to use XFLT2.COM and the CALL command. For

example, to pass all files in the current directory to a batch file named PROCESS.BAT, you'd type the following lines:

```
DIR /a:-d/b | XFLT2 > TEMP$$$$.BAT
TEMP$$$$ CALL PROCESS.BAT
```

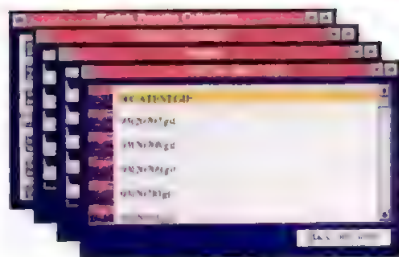
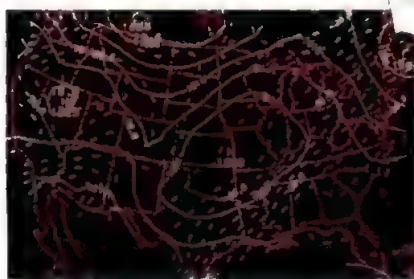
Without the CALL command, the first line of TEMP\$\$\$\$.BAT would transfer control to PROCESS.BAT and never return to TEMP\$\$\$\$.BAT. □

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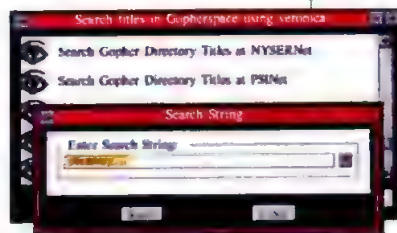
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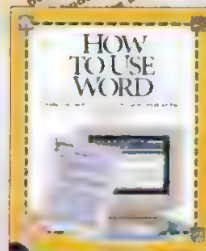
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How to Use the Mouse in Windows

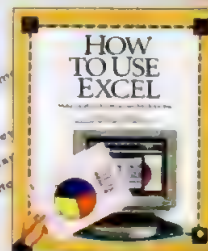
A mouse is a means of giving instructions to the computer. You're probably familiar with the keyboard as the most common input device. A mouse, so named for its hunched over appearance and tail-like cable, is a hand-held input device that along with the keyboard is one of the two input devices most people use routinely in Windows. Although it's possible to get by without a mouse and do all your work from the keyboard, it's not too wise. The Windows interface was designed with the mouse in mind. Keyboard alternatives can be awkward—and it's not always easy to find out what they are. Take a few minutes to learn the mouse moves, and you'll reward yourself with smoother computing.

TIP SHEET

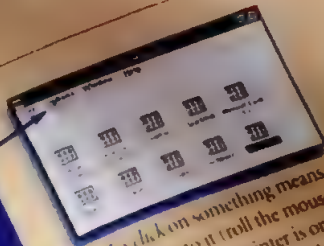
Unless told otherwise, use the left mouse button. The other mouse buttons are used so infrequently that they are always told about it.



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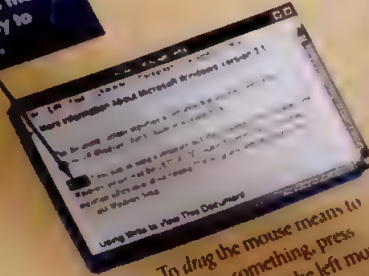
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2

To click on something means to point to it (roll the mouse so the mouse pointer is on top of it) and then press and instantly release the left mouse button. To double click on something means to point to it and then click the left mouse button twice in rapid succession.

Drag across a word to select it. Then press the Delete key to delete it.



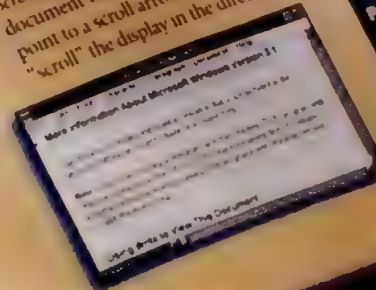
3

To drag the mouse means to point to something, press and hold down the left mouse button, roll the mouse, and then release the mouse button. For example, you can "select" a block of text for deletion by dragging from one end of the block to the other.

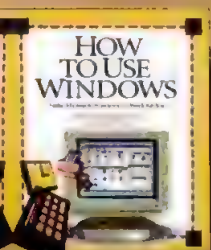
4

Scrolling is one of the most common mouse actions. When a document window cannot accommodate all its contents at once, point to a scroll arrow and hold down the left mouse button to "scroll" the display in the direction of the arrow.

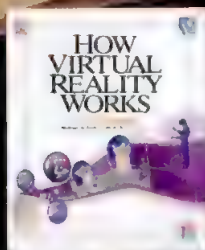
Point here and hold down the left mouse button to scroll down through the document.



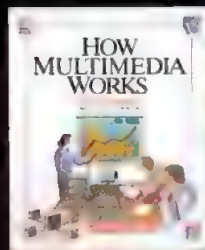
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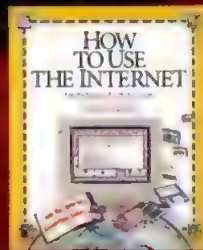
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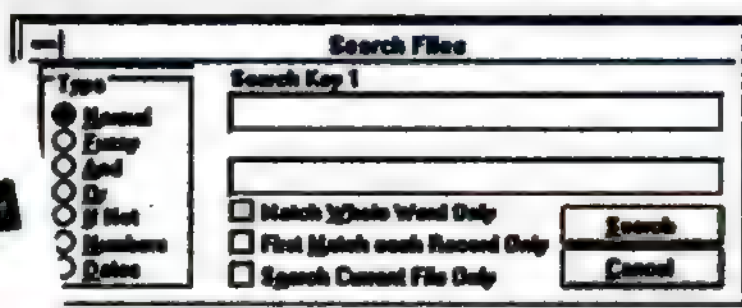
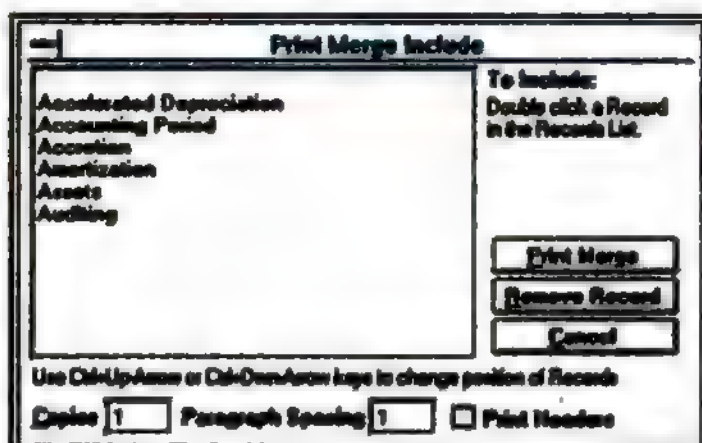
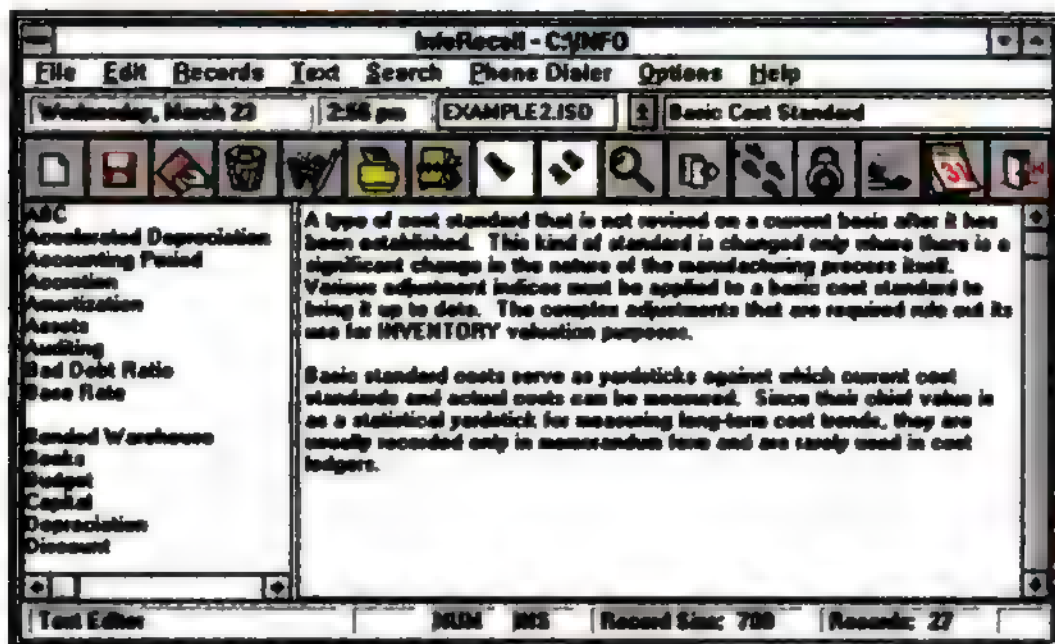
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Tutor

BY JEFF PROSISE

Adventures in Flatland with VxDs

When most of us think about the Microsoft Windows kernel, we think about the system DLLs—GDI, USER, and KERNEL—that provide basic API services to applications. But in reality, the kernel goes much deeper than that. At the lowest level of Windows is the *Virtual Machine Manager*, or VMM. The VMM is a protected-mode program that manages the various virtual machines (VMs) running in the system. Every program you run in Windows resides in one VM or another. The VMM is responsible for creating the system VM, in which all Windows applications run, and for creating additional Virtual-86-mode VMs for DOS sessions. The VMM also manages preemptive multitasking among the VMs. (For more information about multitasking, see the May 17, 1994, Tutor column.)

In a very real sense, Windows is an operating system within an operating system. What we normally think of as Windows runs only within the context of the system VM. When you write a “normal” Windows application—one that calls Windows API functions—you’re programming the “inner” operating system. It’s also possible, however, to program the “outer” operating system. Virtual device drivers, or VxDs, are the vehicles for doing this. The names of most VxDs start with V (for *virtual*) and end in D (for *device*), with the letter or letters in between indicating the device type. That’s why we call them VxDs. The VxD that services the keyboard, for example, is named VKD, for *virtual keyboard device*.

Once installed, a VxD becomes part

of the VMM and enjoys advantages that are not extended to programs inside VMs. For example, a VxD can look anywhere in memory. Conventional programs see only the memory in their VMs. It’s impossible for a DOS application running in a DOS VM to poke around in the system VM, for example. But with a VxD to lend a helping hand, a DOS application can do anything it wants, even if doing so involves crossing VM boundaries.

VxDs are complicated beasts. They are difficult to write and gut-wrenching to debug. But they’re worth the trouble because they provide unparalleled freedom in an otherwise restrictive protected-mode environment. (VxDs work only when Windows is running in 386 Enhanced mode; Standard mode does not support the concept of VMs or VxDs.) At the end of this column, I’ll present a sample VxD that allows DOS applications in Windows to peek at the other VMs running in the system.

WHAT ARE VxDs? VxDs are powerful, 32-bit programs that extend the Windows operating system. They run in ring 0, the processor’s most privileged inner sanctum. (Some programmers call this *flatland*, alluding to the fact that a VxD in ring 0 sees a flat, unsegmented, 32-bit view of memory.) In this mode, programs can reach any address within a 4GB address space without altering the segment

registers (as 16-bit programs must do) and can execute any processor instruction, including those that are *privileged*, or restricted. This means VxDs enjoy unrestricted access to the processor and to the rest of the system.

VxDs are usually written in 386 assembly language and are generally loaded with a `DEVICE=` statement in the [386-Enh] section of `SYSTEM.INI`. Windows itself contains several VxDs that are automatically loaded each time Enhanced-mode Windows is started. (Figure 1 lists some of system VxDs that are part of Windows and the roles they play in the system.) In fact, the VMM is basically a collection of system VxDs contained in the file `WIN386.EXE`.

Most of the system VxDs are provided for the purpose of virtualizing hardware accesses in a multitasking environment, where two or more programs may attempt to use a single hardware resource at the same time. *Virtualizing hardware* means creating the illusion that a hardware resource, such as a COM or a printer port, is local to each VM rather than

globally shared among all VMs. When possible, a VxD coordinates access to a device so that two programs can use it at the same time without interfering with each other. When sharing is not possible (as in the case of a COM port that is actively transferring data), the VxD prevents one program from accessing the hardware that is in use by another program.

In the VMs in which applications run, every I/O port access is subject to validation by the processor and therefore by the operating system’s ring 0 components. This makes it impossible for an application to access hardware that is under the supervision of a VxD without the VxD’s knowledge.

Some of the system VxDs don’t virtualize hardware. Instead, they virtualize software resources (such as DOS’s internal flags and device drivers) or provide services to applications and other VxDs.

They’re complicated beasts to program, but VxDs are worth the trouble because they provide unparalleled freedom in an otherwise restrictive protected-mode environment.

The Microsoft Windows Device Driver Kit (DDK) documents hundreds of services that VxDs can call. Many of these services are provided by the VMM; some are provided by other VxDs. As a whole, VMM and VxD services constitute a low-level Windows API of sorts. The categories of services that are available include I/O

trapping, memory management, and scheduling. Using these services, it's relatively simple for a VxD to perform tasks such as terminating a VM or installing a callback procedure that receives control

A Partial List of System VxDs

Name	Purpose
VMM	Provides virtual-machine management services
V86MGR	Provides API translation services to Virtual-86-mode apps
DOSMGR	Virtualizes parts of DOS, such as device drivers and flags
VPICD	Virtualizes the Programmable Interrupt Controller (PIC)
VDMAD	Virtualizes direct memory access (DMA)
VDD	Virtualizes the display adapter
VMD	Virtualizes the mouse
VKD	Virtualizes the keyboard
VCD	Virtualizes the COM ports
VTD	Virtualizes the system timer
PageSwap	Manages demand-paging operations
PageFile	Manages the virtual-memory swap file

Figure 1: These VxDs, or virtual device drivers, are part of Windows.

when a particular I/O port is accessed.

A VxD can be activated in a number of ways. During installation, Windows calls a VxD's initialization routines several times (the first time from real mode, the

second time and thereafter from protected mode), giving the VxD the opportunity to initialize itself—allocate memory, hook interrupts, and so on. Later, as Windows runs, the VMM sends system-control messages to VxDs, notifying them of changes to the system and to the VMs. One of the most common messages is `Create_VM`, which notifies each VxD in the system that a new VM is being created. If a VxD stores information that is local to each VM, the receipt of a `Create_VM` message is a wonderful time to call the VMM's `_Allocate_Device_CB_Area` service to allocate some memory within the new VM's control block. (The *control block* is a region of memory associated with each VM where information private to that VM, such as the VM ID and the status flags describing the VM's state, is stored.) A VxD can also be activated by an interrupt or by the occurrence of an event for which it has registered a

VTUTORD.ASM

Complete Listing

```

;.....
;
; VTUTORD.386 is a simple VxD that allows a DOS application to determine
; the number of virtual machines in the system. Windows apps run in one VM
; (the system VM), and DOS apps run in separate DOS VMs.
;
; To load the VxD, add a DEVICE=VTUTORD.386 command to the [386Enh] section
; of SYSTEM.INI. To retrieve its entry point from a V86-mode program, call
; int 2Fh with AX=1684h and BX=7FE1h. When the entry point is called,
; VTUTORD returns the VM count in register (E)AX.
;
; Note: The device ID used by VTUTORD is not registered. Therefore, there
; is no guarantee that it will not conflict with other VxDs, although the
; possibility of a conflict is remote.
;.....
.386p

;.....
; INCLUDES
;.....

.XLIST
INCLUDE VMM.INC
.LIST

;.....
; EQUATES
;.....

VTUTORD_Major_Ver equ 1
VTUTORD_Minor_Ver equ 0
VTUTORD_Device_ID equ 7FE1h

;.....
; VIRTUAL DEVICE DECLARATION
;.....

Declare_Virtual_Device VTUTORD,\
    VTUTORD_Major_Ver, VTUTORD_Minor_Ver,\
    VTUTORD_Control,\
    VTUTORD_Device_ID,\
    VTUTORD_API_Proc,

;.....
; PAGE - LOCKED CODE
;.....
VxD_LOCKED_CODE_SEG

;
; VTUTORD_Control receives and dispatches system control messages.
;
BeginProc VTUTORD_Control

    cld                                ;Clear the carry flag and return
    ret

EndProc VTUTORD_Control

VxD_LOCKED_CODE_ENDS

;.....
; CODE
;.....
VxD_CODE_SEG

;
; VTUTORD_API_Proc is the exported API procedure that V86 mode apps can call.
; On return, the caller's EAX register holds the VM count.
;
BeginProc VTUTORD_API_Proc

    mov     ecx,0                      ;Set VM count to 0
    mov     eax,ebx                    ;Save handle of current VM

VAPI_Loop:
    inc     ecx                        ;Increment the VM count
    VMCall Get_Next_VM_Handle          ;Get the next VM handle
    cmp     ebx,eax                    ;Loop back if it isn't the handle
    jne     VAPI_Loop                 ;of the current VM

    mov     [ebp.Client_EAX],ecx       ;Copy ECX to the caller's EAX
    ret                                ;Return to the caller

EndProc VTUTORD_API_Proc

VxD_CODE_ENDS

END

```

Figure 2: This assembly language source code for our demonstration VxD, VTUTORD.386, determines the number of virtual machines running in the system and provides an entry point for DOS applications so that they can have access to this information.



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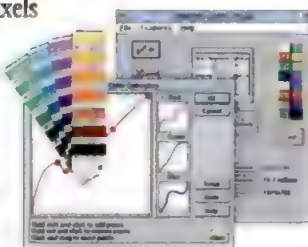
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DEBUG Script for Creating VMCOUNT.COM

Complete Listing

```

A 100
JMP 015A
DB "Requires enhanced-mode Windows$"
DB "Virtual device VTUTORD is not loaded$"
DB "Number of VMs: $"
DB 0,0,0,0
MOV AX,1600 ;See if Enhanced-mode
INT 2F ;Windows is running with
MOV DX,0102 ;Int 2Fh, AX=1600h
TEST AL,7F
JZ 0194 ;Error if it is not
MOV AX,1684 ;Get the VxD's V86-mode
MOV BX,7FE1 ;entry point (BX=device
INT 2F ;ID)
MOV [0156],DI ;Save the entry point
MOV [0158],ES ;address returned in ES:DI
CMP DI,00 ;Error if both ES and DI
JNZ 0185 ;are 0 (VxD is not loaded)
MOV DX,0121
CMP WORD PTR [0158],00
JZ 0194
MOV AH,09 ;Print "Number of VMs:"
MOV DX,0146
INT 21
CALL FAR [0156] ;Call the VxD's entry point
CALL 0199 ;Print the number in AX
RET ;Finished
MOV AH,09 ;Subroutine to convert the
INT 21 ;value in AX to ASCII format
RET ;and output it to the screen
MOV BX,0A ; .
XOR CX,CX ; .
INC CX ; .
XOR DX,DX
DIV BX
PUSH DX
OR AX,AX
JNZ 019E
POP DX
ADD DL,30
MOV AH,02 ; .
INT 21 ; .
LOOP 01A8 ; .
RET ;End of subroutine

N VMCOUNT.COM
RCX
B3
W
Q

```



Figure 3: This DEBUG script creates a program that accesses the number of running VMs from VTUTORD.386 and then displays that number.

callback (such as a port access). And, of course, a VxD can be activated when called by another VxD.

A VxD can also be activated by an application program. One of the most exciting aspects of VxDs from an application programmer's perspective is that VxDs can "publish" entry points for applications running in VMs so that the applications can call VxDs directly. Suppose you are writing a DOS application that will run in Windows and want to access information stored in the DOS VM's control block. A DOS application can't access a VM control block directly, because the

control block is located outside the VM. But a VxD can access anything it wants to. To enable a DOS application to read a VM control block, you can write a VxD that provides an entry point to a Virtual-86-mode API handler. The application could then call the entry point using the VxD's ID number (every VxD has a unique ID; IDs are stored in a central database managed by Microsoft). The VxD could, in turn, read the control block and pass the information back to the DOS application. Just like that, the DOS application did something it was never supposed to be able to do: It crossed the VM

boundary and went foraging outside its own virtualized address space.

VxDs can allow applications running in the Windows environment to do all sorts of things that would otherwise be impossible. For example, it's relatively easy to write a VxD that permits a Windows application running in the system VM to send a message via interrupt 2Fh to a DOS application in a DOS VM. The Microsoft Developer Network CD-ROM contains a sample VxD that lets an application determine whether a DOS VM is running as a window or full-screen. I wrote a modified version of this VxD—one that lets a DOS application determine the state of its own VM—in *Microsoft Systems Journal's* MS-DOS Q & A column of May 1994.

With this power comes responsibility. A VxD is a convenient mechanism for breaking the rules and working outside the confines of Windows VMs. However, a buggy VxD can (and almost inevitably will) bring the system crashing to the ground. And a poorly written VxD can degrade system performance. VxDs are best used sparingly. But they're too important to ignore completely, because when used properly, they bring an unprecedented amount of power and flexibility to the Windows environment.

A SAMPLE VXD Space doesn't permit us to discuss the structure of VxDs in detail, but that won't prevent us from looking at a simple VxD. Figure 2 lists the source code for VTUTORD.386, a VxD that determines the number of VMs running in the system and passes that information to DOS applications. Figure 3 is a DEBUG script that creates a short DOS program named VMCOUNT.COM, which lets you access VTUTORD.386 from the DOS command line of a 386 Enhanced-mode DOS window. For a discussion of the programming strategy behind VTUTORD.386 and VMCOUNT.COM, see the sidebar "Programming a Simple VxD."

Normally, a DOS application running in a VM has no way of knowing how many other VMs are also running. But a VxD sees all and knows all. With VTUTORD loaded, DOS applications can easily get a count of the other VMs in the system.

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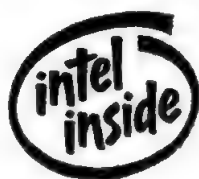
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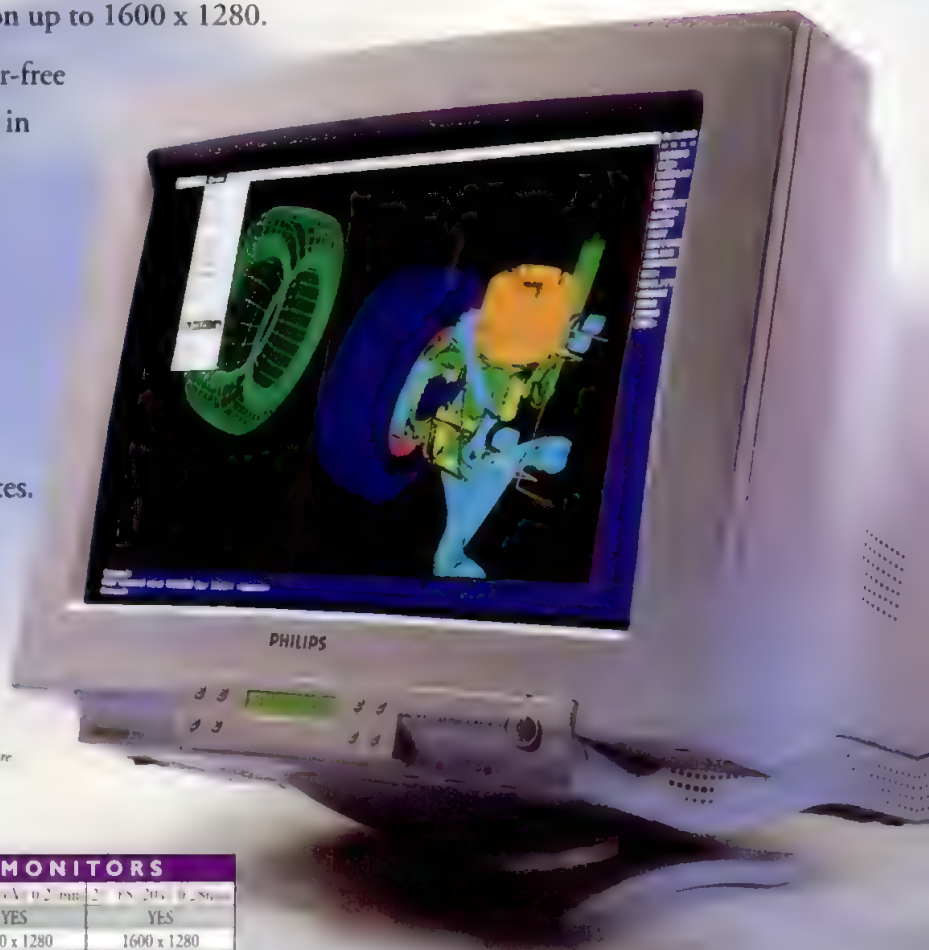
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■ Programming a Simple VxD

VTUTORD contains three components: a virtual-device declaration block, a procedure that receives and dispatches system control messages (VTUTORD_Control), and a procedure that fields calls from Virtual-86-mode applications (VTUTORD_API_Proc). The device-declaration block contains important information about the VxD that is needed by the VMM: the VxD's name, its major and minor version numbers, the address of VTUTORD_Control, the device ID, and the address of VTUTORD_API_Proc. When the VMM sends a system-control message to VTUTORD, the VTUTORD_Control procedure takes over. Our VxD doesn't process any control messages, so VTUTORD_Control simply clears the carry flag (indicating that no error occurred) and returns.

When a DOS application calls VTUTORD's entry point (whose address is obtained by calling interrupt 2Fh with AX set to 1684h and BX holding the VxD's ID number), the call comes to VTUTORD_API_Proc. On entry, EBX holds the handle of the current VM, and EBP holds the address of the *client register structure*, which holds an image of the caller's registers. VTUTORD_API_Proc saves the 32-bit handle of the current VM in EAX and calls Get_Next_VM_Handle repeatedly until the VM handle returned in EBX matches the

handle of the current VM. A counter (register ECX) is incremented each pass through the loop. At the end, the counter holds a count of the number of VMs. This information is passed back to the DOS application in the EAX register by copying the value in ECX to the Client_EAX field of the client register structure.

VMCOUNT calls VTUTORD and displays the value returned in AX. To do this, VMCOUNT first verifies that Enhanced-mode Windows is running, by calling interrupt 2Fh with AX equal to 1600h:

```
MOV AX, 1600
INT 2F
.
.
.
TEST AL, 7F
JZ 0194
```

If Enhanced-mode Windows is not running, AL will return set to 00h or 80h, and VMCOUNT will branch to 0194, which prints a message and terminates the program. If 386 Enhanced-mode Windows is running, VMCOUNT obtains the address of VTUTORD's Virtual-86-mode entry point by calling interrupt 2Fh with AX equal to 1684h:

```
MOV AX, 1684
MOV BX, 7FE1
```

To see VTUTORD and VMCOUNT in action, download a copy of VTUTORD.386 from PC MagNet. Look for the file VTUTOR.ZIP in the Tutor section of the Utilities/Tips Forum. Add the statement `DEVICE=VTUTORD.386` to the [386Enh] section of SYSTEM.INI (include a path if VTUTORD.386 is stored somewhere other than your Windows directory) and start Windows. Then open a DOS box and run VMCOUNT. It should report the number of active VMs. If you have one DOS window open, VM-

COUNT will report that there are two VMs active: the DOS VM and the system VM. Each DOS window constitutes one VM, and Windows itself constitutes another.

FURTHER READING If you're interested in learning more about VxDs, let me suggest three further sources of information. The ultimate source is the Windows DDK, which is available from Microsoft. It contains all the official documentation for writing VxDs as well as the software you need. There are also

INT 2F

BX holds the device ID, which is defined in VTUTORD.ASM as 7FE1h. (An application must know the VxD's ID in order to call it. I chose this device ID arbitrarily; it is not registered with Microsoft. Since our VxD ID is not registered, there's no guarantee it won't conflict with other VxDs, so don't try this at home! If you write VxDs, contact Microsoft and obtain a registered VxD ID.) The entry-point address is returned in ES:DI. If both ES and DI return 0, the VxD is not installed, and VMCOUNT prints an error message and terminates. If a valid entry-point address is returned, VMCOUNT calls the VxD with

CALL FAR [0156]

Since VMCOUNT copies the address returned in ES:DI to the double word at offset 0156h, a CALL FAR instruction referencing that address performs a far call to the VxD's entry point. On return, AX holds the number of active VMs, and VMCOUNT prints the number by calling the subroutine at offset 0199h. (If you have the Windows DDK and want to assemble VTUTORD from scratch, you'll need to download the module-definition file VTUTORD.DEF.)

two helpful books on the subject, both from Addison-Wesley. One is Dan Norton's *Writing Windows Device Drivers*, which discusses VxDs and other types of Windows device drivers. The other is *Writing Windows Virtual Device Drivers*, by David Thielen and Bryan Woodruff. *Writing Windows Virtual Device Drivers* contains, among other things, a scaled-down version of the DDK, called VxD-Lite, which includes the software tools you need to build VxDs of your own. □

A cowboy wearing a white hat and a light blue patterned shirt is riding a rocket-shaped computer upgrade kit. The rocket is white with black portholes and is angled upwards. The upgrade kit itself is a complex assembly of various computer components, including circuit boards, chips, and connectors, all integrated into the rocket's structure. The background is a blurred, colorful scene of a fair or carnival, with white railings and various lights.

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CIRCLE 318 ON READER SERVICE CARD

Corporate Developer

BY CHRISTINE COMAFORD

A Guide to Controls And Window Types

Corporate developers designing a graphical user interface (GUI) often face a double-edge sword: A well-designed user interface leads to reduced end user training and support, while a poorly designed interface mires users in a mind-numbing plethora of haphazard controls and dialog boxes. Since there are a number of different types of controls and windows, the successful GUI designer needs to have a firm understanding of when it's appropriate to use one control over another. Just as the plenitude of cheap fonts has led to ransom-note typography, the number and quality of today's custom-development controls often lead developers to ransom-note control usage. In this column, you'll learn more about the basics of windows and controls that serve as the foundation for a well-designed user interface.

OPENING WINDOWS As the name of the operating environment would lead you to believe, windows are the fundamental objects through which most user interaction takes place. Like the wise man who built his house upon the rock, your Windows application needs a solid foundation upon which to add functionality.

As you develop Windows applications for other users within your company, your goal always should be to maintain as much consistency with other Windows applications as possible. Why force a user to learn some new or inconsistent action when you could make a design decision to use a standard control or behavior that's already known to the user? Let's start with a review of the kinds of windows that you can use in your application

and when to use each one.

Window types include primary (also called *application* or *main*) windows, multiple document interface (MDI) windows, MDI child windows (also referred to as document windows), and dialog boxes. Applications routinely create and use other windows that include dialog boxes, MDI child windows, and non-MDI child windows.

CHOOSING THE RIGHT WINDOW If users will be working with a variable amount of data but just one type of data, use a standard main application window, as the Write and Notepad accessories do. If your program needs to provide access to multiple sets of data or to multiple views of one data set, make the main window an MDI window and display the data sets in MDI child windows. Program Manager is the most ubiquitous

example of an MDI program. Finally, if your program's interaction with the user is simple and straightforward, consider using a simple dialog box as the main application window. The Calculator and Character Map accessories are two examples of programs whose main window is a dialog box. Figure 1 shows three of the four types of windows that are available to you:

• **Application windows.** The main application window usually contains a resizable frame and a title bar. In addition, application windows should have a control-menu box, and minimize and maxi-

mize buttons. To make matters a bit more complicated, the main window can be just a dialog box, in which case the user won't be able to size the window frame. If your main application window is a dialog box, include a control-box menu and a minimize button but not a maximize button.

• **MDI windows.** An MDI window is capable of creating and managing multiple MDI child windows. Just as Windows manages a desktop full of main program windows, an MDI application manages a set of MDI child windows, also called document windows. Document windows can be tiled or cascaded within the MDI window, and they can be reduced to icons, again within the MDI window. The child windows always stay completely inside the main program window.

In general, if your application calls for complex data entry or the ability to view multiple data elements, use a main MDI window and create MDI child windows as necessary. Before you begin designing your application, spend some time thinking about the way you plan to present data to the user. If there's any chance that the user would need to open another window while halfway through the work process, choose the MDI window option. That way, your application can open up an MDI child window, let the user interact with the data, and then return to the original work.

• **MDI child windows.** The third kind of window is the MDI child window. MDI child windows share almost all the characteristics of an application window. They can be resized, minimized, and maximized but always within the main MDI window. When an MDI child window is maximized, its title is appended to the title of the main MDI window (for example, "Program Manager - [Main]").

The ability to open more than one MDI child window lets your application display more than one data set or more than one kind of data set. Users can either work on many data sets at once or

In this column, you'll learn more about the basics of windows and controls that serve as the foundation for a well-designed user interface.

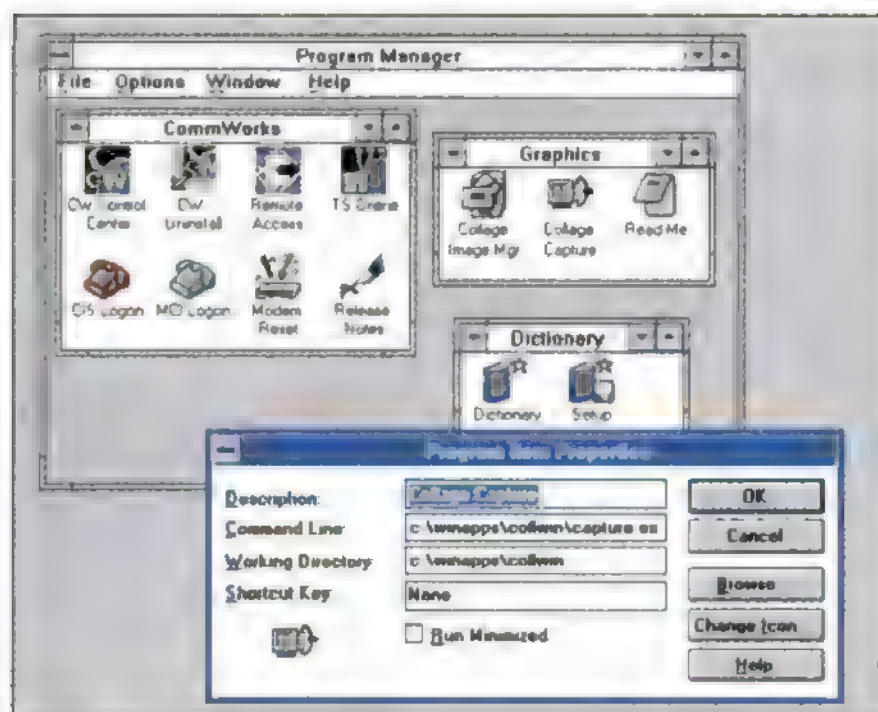


Figure 1: Three of the four available window types are shown in this figure. The main application is an MDI window that contains MDI child windows. The dialog box is also considered a window.

easily compare the contents of similar forms. For example, consider a purchase-order application where, after working through the first half of the PO, the user might have to enter information about a customer. If the user tries to edit a customer record that doesn't exist, he shouldn't have to exit from the order screen and lose all of the data already entered just to enter a new customer. Why not just open an MDI child window to enter the new customer information, save the data, and then close the window before continuing?

Because the term *document* might be confusing, it's acceptable to call these windows by more appropriate names that refer to the context of the data. For example, Figure 2 shows Program Manager with two open document windows called Main and CommWorks. Although the Program Manager refers to these as group windows, they are still just MDI document windows. On the other hand, if the application is Microsoft Word for Windows or WordPerfect, it's correct to refer to these windows as documents.

As you design your applications, give some thought to how many MDI windows the user can open at one time. For example, if you're developing an application for entering purchase orders, you might permit the user to work on multiple purchase orders in multiple document windows at the same time. If you also let him have a customer window

open for each purchase order, chances are good he'll be confused by all the windows splashed across the screen. I've found that providing multiple instances of the primary objects and single instances of the peripheral objects works well.

• **Dialog boxes.** Dialog boxes provide a two-way interaction between the application and the user. On one hand, applications use dialog boxes to get more information from the user before a command can be completed. The controls that you use in a dialog box collect information and pass that information back to the application. On the other hand, dialog

boxes also present data to the user via message boxes and the initial values of controls displayed in the dialog box. Dialog boxes can have a minimize button (and perhaps they should if the dialog box is the application) and even a menu bar.

Let's take a moment to bone up on the three types of Windows dialog boxes: modeless, modal, and system modal. What you want your application to accomplish will dictate the kind of dialog box you implement. Choose modeless dialog boxes for on-going tasks or to present information that will be helpful to keep on the screen for a while. For example, many applications implement a Find dialog box that stays visible so that the user can select Find Next several times before closing the dialog box. Figure 3 shows Word for Windows 6.0's spell-checker, a good example of a modeless dialog box. Toolbars are often implemented as modeless dialogs. Users can continue to work in the application even when a modeless dialog box is active.

Use modal dialog boxes when the application needs a specific piece of information before it can continue. Once the user supplies the necessary information or cancels the operation, the dialog box closes and the application continues. A good example of a modal dialog box is the File|Open dialog box present in

most applications. In this case, the application can't work on the file until the user either tells it which file to open or cancels the process of opening a file. Once the user selects the filename or cancels the operation, there is no reason to keep the dialog box around, because it will only clutter the screen. When a modal dialog box is active, the user cannot do anything else in the application until that dialog has been closed. Use this kind of dialog box sparingly.

System modal dialog boxes are rare and should be used only when the user's response is required for some problem relating to the whole system. Chances are good you'll never use these, because when this type of modal dialog is active, the user can't do anything in *any* application until the dialog is closed. An example of this kind of dialog box is a fatal hardware error or an impending systemwide memory shortage.

Another use of the dialog box is to present informational, warning, or critical messages to users. Let's spend a couple of paragraphs on the message box, since your users will see a lot of them during their time spent with Windows!

Some message boxes simply convey information or issue a warning—"File not found," for example—and an OK button to clear the message after the user has read it. For these cases, you might display just a button that dismisses the dialog box when the user is done reading the message. Other dialog boxes want a



Figure 2: The Windows Program Manager is an MDI application that uses MDI child (document) windows for program groups. In this example, two MDI child windows—titled Main and CommWorks—are visible.

clarification from the user before proceeding: "It's Tuesday. Fax standing order to the pizza shop?" accompanied by Yes and No buttons. Finally, some message boxes present a query with the option to answer Yes, No, or Cancel: "Overwrite existing file?"

"I'm a vice president because I sold 22,000 gizmos this year. How'd you become a v.p.?"

"I made a great deal on the 200,000 gizmos you didn't sell last year."



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Message boxes contain one of four standard icons. A stop sign indicates a critical error, a circled exclamation mark represents a warning message, and a circled letter *i* means an informational message. Some message boxes display a circled question mark when asking a question of the user, but since the question mark is often associated with Help, its meaning in the context of a message box is ambiguous and shouldn't be used.

DON'T BE A CONTROL FREAK Controls are those interface elements (command buttons, scroll bars, list boxes, edit boxes, and so on) that handle interaction with the user. In most cases, controls serve both to get information from the user and to display information about the current application status. For instance, scroll bars in a word processor not only let the user move around within a file but also display the user's current position within that file. Radio buttons (which are described below) both show the current selection and let the user change that selection.

Right out of the box, Windows provides a number of controls that you can use when designing an application. Although you might be tempted to use a wide variety of custom controls (including the numerous Visual Basic .VBX con-

Figure 4 shows a dialog box containing some of the common Windows controls that you can use in your applications. Let's spend a few moments reviewing each of the controls and when it's appropriate to use them.

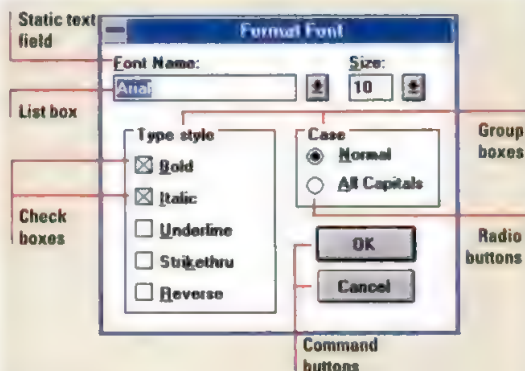


Figure 4: This dialog box contains most of the common Windows interface controls. Each labeled item is described in more detail in the text.

• **Command buttons.** A command button is a rectangular button that contains a label describing a command or action that the application will carry out when the button is pressed. The button labels are usually text, but many applications also use bitmapped images on a command button. Users can either click on the command button or hold down the

Alt key while pressing the underlined character that appears on the button's caption. These keyboard shortcuts are an essential part of good interface design.

Use care assigning labels for keyboard shortcuts, and ensure that no two controls in a dialog box are mapped to the same keyboard shortcut. You're heading for a train wreck if you define the keyboard shortcut of O for both the Orders command button and the OK command button. Wherever possible, use the first letter of the label as the keyboard shortcut, but if that creates a conflict with another label, choose another letter that makes it easy for the user to remember the command.

Place the standard command buttons—usually OK and Cancel—in one consistent location for all of your appli-

cation's dialog boxes and the buttons for other features in a different consistent location (perhaps stacked vertically above the OK and Cancel buttons). Remember to provide keyboard shortcuts for all menu items and controls (except the OK and Cancel buttons, which should be mapped to the Enter and Esc keys, respectively). Every Windows program should be completely operable using only the keyboard, unless its function depends solely on another type of input device, such as a mouse or a puck.

• **Radio buttons.** Use radio buttons (sometimes called option buttons) as a way to present a single choice from a limited set of mutually exclusive choices. The control gets its name from the old car radio buttons of the fifties and six-

ties: Push one button and the others pop out. Radio buttons are represented graphically as a circle that is filled when the user chooses that option. Use radio buttons when the number of choices is limited to usually no more than four or five choices. If you need to present more than five choices, use a standard or drop-down list box.

• **Check boxes.** Choose check boxes if you want to present a list of choices to the user where they can make more than one selection from the list. Check boxes are represented by squares that display an X when the option is selected and are blank when the option is deselected. (Some applications have check boxes that use a check mark instead of an X.) As you can see in Figure 4, you can assign keyboard shortcuts to both check boxes and radio buttons—a feature your laptop-equipped mobile executives with limited mouse real estate will certainly appreciate.

• **List boxes.** A list box normally displays a column of choices. If there are too many choices to display at once, a scroll bar to the right of the list lets the user scroll through the choices. By default, list boxes let the user select only one item, although you can design a list box to permit multiple-item selection. In addition, another flavor of list box, called a combo box, lets you present

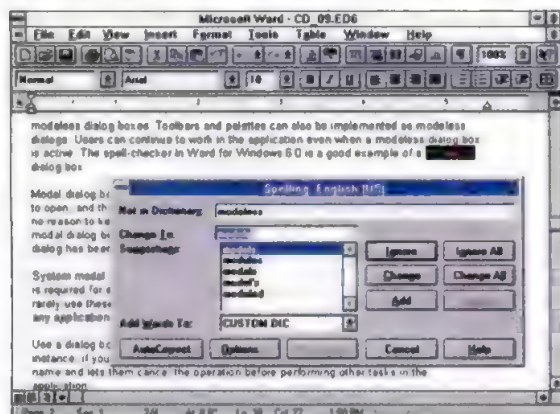


Figure 3: The Microsoft Word for Windows spell-checker is a good example of a modeless dialog box. You can move around the document and edit text even with the dialog box active.

controls), you should carefully consider using existing controls before using a control that might be unfamiliar to users. To a new Visual Basic or PowerBuilder developer, it's really easy to lose control and try out each of the custom controls found in those environments.

multiple items to the user but permits him to type in his own response if the correct one isn't on the list.

Because it's easy to add or subtract data elements from the list, consider using list boxes for single or multiple se-

provides labels for the controls, but it's up to you to label other controls. Keep static text strings short and align data-entry fields to make navigation easier. Be consistent when labeling controls by developing a list of reserved words for

If you choose the right window and control elements for your Windows-based applications, you'll be rewarded with more productivity and fewer headaches.

lections when the features or data that you present to the user is dynamic. Drop-down lists and combo boxes are an attractive option when screen real estate is limited or when the user won't need to access the list of choices very often.

- **Text boxes.** Text boxes are controls into which the user types information. Within the text box control, the user may

navigate text by pressing the Left or Right Arrow key and select text by holding down the Shift key while pressing the Left or Right Arrow key. Text boxes also support navigation and selection with the mouse. Text boxes can be of the single-line or multiline variety. The Windows Notepad is just one multiline text box with a menu bar. The dialog box in Figure 1 contains four single-line text boxes.

- **Static text fields.** Be sure to label your controls with static text fields. In some cases—that is, for buttons, check boxes, and group boxes—the operating system

controls in order to prevent multiple meanings of the same word. For example, I have seen the OK button used in non-standard ways, such as to close one window and invoke another. This behavior is both inconsistent and confusing.

- **Group boxes.** Finally, use group boxes to group together related controls and to provide visual consistency

throughout your dialog boxes. Although group boxes are technically considered controls, the user can't manipulate them with the mouse or the keyboard. The most common use of a group box is to enclose groups of radio buttons or check boxes.

HONEY, I HID THE CONTROL Consider whether you want to disable unavailable menu items and controls (leaving them visible but grayed out) or hide them. In general, graying a control is much safer. Users are often confused when menu items or controls keep appearing and

disappearing. The only reason to hide GUI components is if the user will never have access to specific menu items or controls. For example, you might choose to hide certain controls in a window or dialog box based on the user's security level at log-on. Another reason to leave disabled controls in place is if you've provided context-sensitive help. That way, users can tab to the disabled control and press the F1 to get context-sensitive help in order to figure out why they can't access the control.

CONCLUSION Figure 5 summarizes the issues you should consider when using controls in dialog boxes. While Windows controls can often accommodate a large number of choices, it's not a good idea to explore that limit with your users. Note, for instance, the suggested maximum number of choices for a list box. I've found that users get frustrated after hitting PgDn or scrolling through 50 or more items. With a longer list, consider providing a method for reducing the list to create a subset from which the user can choose. A simple data-entry field where the user can enter a partial string to search on would work well, for example.

If you find that you're spending a lot of time with user-interface issues, you owe it to yourself to look into *The Windows Interface: An Application Design Guide* (Microsoft Press, ISBN: 1-55615-439-9). This interface bible is the definitive compilation of Windows UI arcana, from accelerator keys to z-order, with discussions on both the appearance and the behavior of Windows interface elements. This book is essential when setting corporate standards.

Choosing the right window and control elements for your Windows-based application forms a strong foundation for the rest of the application. If you make the right choices and don't try to get too far out onto the bleeding edge of interface technology, you will be rewarded with more productivity and fewer support headaches. Making the wrong choice, on the other hand, is the stuff GUI nightmares are made of. □

Deciding on Controls for Dialog Boxes

If you want to	Use a	But no more than...
Trigger an action	Command button	Six per dialog box
Choose among a few mutually exclusive options	Radio button	Six per group
Choose one or more of a few nonexclusive options	Check box	Ten per group
Get arbitrary text data from the user	Text box	
Choose among mutually exclusive options	List box	50 items, displayed 8-10 at a time
Choose one or more nonexclusive options	Multiple selection list box	50 items, displayed 8-10 at a time
Choose among mutually exclusive options while using a minimum of space	Drop-down list box	20 items, displayed 1 at a time
Choose among mutually exclusive options or enter a new value	Combo box	20 items, displayed 1 at a time
Group related controls, especially radio buttons and check boxes	Group box	
Label controls that don't have their own labels (list boxes, for example)	Static text field	

Figure 5: This table summarizes the available standard interface elements and shows recommended limits to the number of controls that you should use in a single dialog box. Too many controls and the dialog box becomes difficult to understand.

CHRISTINE COMAFORD IS PRESIDENT OF CORPORATE COMPUTING INC., A USER-INTERFACE AND CLIENT/SERVER DEVELOPMENT CONSULTING FIRM. SHE CAN BE REACHED VIA MCI MAIL (371-9004).

Toolkits

BY PETER G. AITKEN

Update Programs With a Patch

Whether for a simple bug fix or a completely new release, getting updated versions of program files to end users can be a major expense. UpdateIt!, Version 1.0, and .RTPatch, Version 2.01, can help. They compare new and old versions of files and create a patch file that encodes the differences. You then send just the patch file to end users, and since a patch file is much smaller than a complete set of new files, it is less expensive to distribute.

Patching is most useful when making small to moderate changes to large files. For upgrades involving a few small files or for major changes, it's better to distribute the changed files in their entirety.

The patch technique is useful not only for updating programs but also can be useful in any situation where old versions of files must be replaced with new versions. For example, if you work on the same data files at the office and at home, you can create a patch file to transport the modifications back and forth. Another application would be in a nonnetworked office where several users need access to the same data files.

UPDATEIT! AND .RTPATCH UpdateIt! is not really a new product: It's a revision of Hyperkinetic's DeltaFile, which Innovative Data Concepts recently purchased. .RTPatch is the better known of these two products. Version 3.0 will ship by the time you read this but was not available for review even as beta. For Version 3.0, Pocket Soft promises substantial increases in patch-file build speed and a decrease in

the size of certain types of patch files.

Both programs provide the basics. You can select files to process either by name or by subdirectory location. In addition to modifying existing files, you can add new files and delete unneeded ones. A backup option saves a copy of the user's old files. Passwords can prevent unauthorized use of the patch file. When the patch is applied, the files to be modified are validated by a cyclic redundancy check (CRC), both before and after modification. You can use a single patch file to update different versions of your product—for example, from either Version 1.0 or Version 1.1 to Version 2.0. Patch files can preserve user-specific information, such as a product serial number or the user's setup data, in the target files.



The UpdateIt! package includes four separate versions of the program, one each for DOS, Windows, OS/2 character mode, and OS/2 Presentation Manager. You use menus and dialog boxes to specify the patch-file contents and options. The graphical interface is not particularly intuitive but is easy to use once you get used to it. Session settings can be saved in a configuration file for reuse. UpdateIt! also provides a utility program for performing binary comparisons between files. Documentation consists of a 43-page stapled booklet that, while complete, lacks clarity and organization.

While not quite as easy to use, .RTPatch offers a variety of advanced options and safety features that are not available

with UpdateIt!. .RTPatch is a command line-only DOS program that can also be run in a DOS box under Microsoft Windows or OS/2. You use command line arguments to build simple patch files. For more complex jobs that use .RTPatch's advanced options, you must use a text editor to create a file with the needed commands.

Among its more important advanced features is the option to keep the old files intact and ready to run until the entire patch has been applied and verified. (UpdateIt! will keep a backup of renamed copies of the old files, but the user must restore them manually.) Also, .RTPatch lets you split large patch files across multiple disks. The 127-page manual is clear and complete.



We tested both programs in a variety of situations, ranging from minor patches of only a few files to major upgrades involving multiple megabytes; both always produced 100-percent accurate patches. Patch-file sizes were roughly comparable. .RTPatch has a size disadvantage with small patches, because PATCH.EXE (45KB)

must be distributed along with the patch file. UpdateIt!'s patch code is much smaller and is distributed with the patch data as a self-executing file. UpdateIt! was somewhat faster in creating the patch file for small jobs, but .RTPatch was much faster for large jobs. There were no significant speed differences when applying the patch.

Both .RTPatch and UpdateIt! do a reliable job of creating patch files. If ease of use is important and your patching needs are relatively simple, take a look at UpdateIt!. For large or more complex updates, .RTPatch has the edge.

• UpdateIt!, Version 1.0

List price: \$249. Requires: 286 or better, 1MB RAM, DOS 3.1 or better, Microsoft Windows 3.x or OS/2 2.x. Innovative Data Concepts, 122 North York Rd., #5, Hatboro, PA 19040; 800-926-4551, 215-443-9705; fax, 215-443-9753.

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Environments

BY CHARLES PETZOLD

Font Selection Under Windows NT

I've always been annoyed at Windows technical documentation. It's never been quite precise enough for my tastes. Very often, you'll manage to find the right function calls to execute some procedure, but questions still remain about the actual internal implementation. The only solution is experimentation, and that can often take more time than you're willing to spend. Even when you get the feature working, you wonder if the details will change in the next version and break your code. Some people call this process "heuristic programming." Others call it "empirical programming." Most just call it a pain in the butt.

We saw a good example of this problem in a previous Environments column. The question involved how Windows NT handles graphics paths. When constructing a path, your program calls line-drawing functions. The coordinates passed to these functions are in logical coordinates. At some point, the Windows Graphics Device Interface (GDI) has to convert these logical coordinates to device coordinates (pixels). So, does this conversion take place at the time the path is created or at the time the path is rendered?

It's a good question, but you won't find the answer in the documentation. You must find out for yourself, and you'll generally have to do this after you try something that doesn't work right, which in my case was the PathToRegion function. Inevitably, this happens late at night, long after you've already blown your deadlines. As it turned out, I discovered that GDI converts logical coordinates to device coordinates at the time the path is created. I would have pre-

ferred that this vital information be documented as part of the description of the BeginPath function.

We encounter a similar problem when it comes to using fonts and displaying text. In our quest to ease the use of TrueType fonts under Windows NT, we'll also encounter other obstacles and problems. That's what this column is all about: Facing off against programming gremlins, showing them who's the boss, and then blowing them away.

FONT SCALING In general, displaying text requires four steps:

1. Create a logical font by calling the CreateFont or, more commonly, the CreateFontIndirect function. The latter function involves using a LOGFONT structure. Both these functions return a handle to the font of type HFONT.

2. Select that font into a device context using SelectObject.

3. Obtain information about the selected font using GetTextMetrics or GetOutlineTextMetrics.

4. Display text using TextOut or one of the other text-output functions.

The lfHeight parameter to CreateFont (which is also one of the fields of the LOGFONT structure) specifies the height of the font characters in logical coordinates. Naturally, GDI must eventually convert this height to device coordinates (pixels). When does this conversion occur?

If you think about it, GDI can't per-

form the conversion during the CreateFont or the CreateFontIndirect function. These functions create a logical font that is independent of any device context. GDI cannot possibly convert logical coordinates to device coordinates unless it has a particular device context in mind.

So now we're faced with an easier question: Does GDI convert logical font heights to pixels when the font is selected in the device context or when the font is rendered? I won't keep you in suspense: It's the latter. This isn't quite consistent with how paths are handled, but it is consistent with how GDI handles pen widths. Pen widths in logical units are also converted to device coordinates at the time a line is rendered.

This particular behavior of GDI is good news. As you saw in a previous column, you can use the Windows NT world transform to translate, scale, shear, or rotate GDI coordinates. This means that you can create a 12-point font, select it into a device context, and then use the

In our quest to ease the use of TrueType fonts under Windows NT we'll have to face off against the programming gremlins and show them who's boss.

world transform to display the font in double size or half size. If the conversion from logical sizes to pixels occurred during the SelectObject function, you'd need to recreate the font and select it into the device context each time you wanted to apply a different world transform.

On the other hand, you need to know how GDI handles font heights to write intelligent Windows programs that use fonts. This is the problem that caused me to delve into the whole subject of world transforms in the last issue.

GETTING THE POINT I believe that with the advent of scalable vector fonts, such as TrueType, programmers who write text-handling code should become very familiar with classical typography. In particular, Windows programmers should become accustomed to specifying font sizes in points.

Traditionally, a point is equal to 0.01384 inch. This number is so close to

1/72 inch that computer typography uses the latter measurement instead. The point size of a font is commonly described as the distance between the lowest descender and the highest ascender of letters of the Latin alphabet (not including accent marks). This is only approximate, however. For a particular point size, the designer of the font may choose to make the actual characters somewhat larger or smaller than the point size would indicate.

EASY FONT CREATION With TrueType, when you begin thinking of fonts in terms of point sizes, font creation should actually be easier than it normally is. We should be able to use a function like this:

```
hFont = EzCreateFont (szFacename,  
    cyDeciPts, cxDeciPts,  
    iAttributes) ;
```

I'll devote the rest of this column to the problems you can encounter when setting out to write such a function.

The first parameter is the face name of a TrueType font, such as Times New Roman Italic. The second parameter is the height of the font in decipoints, which are tenth points. Decipoints give you the freedom to specify a 12.4-point font, for example.

Normally, you'd set the third parameter of the EzCreateFont function to the same as the second parameter. This is sometimes called the *em-width* of the font and describes the width of the font in points. In the early days of typography, a capital *M* was as wide as it was high, leading to the concept of an *em-square* and to the origin of the *em-width* measurement. When the *em-width* equals the *em-height* (the point size of the font), the character widths are as the font designer intended. A smaller or wider *em-width* lets you create slimmer or wider characters.

The last parameter of EzCreateFont specifies attributes. When using TrueType fonts, you'd normally use only the underline or the strikeout attributes. You could also use boldface or italics, but these attributes are usually part of the face name.

Before we actually write an EzCreateFont function, however, we'll have to deal with a few problems.

DEVICE RESOLUTION VERSUS LOGICAL RESOLUTION One chore of the EzCreateFont function is to convert a point size to logical units in order to set up the LOGFONT structure. The point size must first be converted to device units (pixels), however, and then to logical units. To perform the first step, we'll use information available from the GetDeviceCaps function. This function returns information particular to a device context, so we'll have to include another parameter to the EzCreateFont function—a device context handle.

Calling GetDeviceCaps with the HORZRES and VERTRES parameters gives you the width and height of the video display or the printable area of the printer page in pixels. Let's assume you've obtained these values and stored them in variables *cxRes* and *cyRes*.

Calling GetDeviceCaps with the HORZSIZE and VERTSIZE parameter gives you the physical width and height of the video display or the printable area of the printer page in units of millimeters. Assume these values are stored in the variables *cxSize* and *cySize*.

To obtain the resolution of the device in dots per inch, use the following formulas:

$$cxDpi = 25.4 \times cxRes / cxSize$$
$$cyDpi = 25.4 \times cyRes / cySize$$

The value 25.4 is the number of millimeters per inch. Let's call these values the *normal resolution* of the output device. For reasons that I'll discuss shortly, I'm using the word *normal* to avoid words like *true* or *actual*.

The above formulas are fairly straightforward, but there's an alternative approach. You can directly obtain the device resolution in dots per inch using the LOGPIXELSX and LOGPIXELSY parameters to the GetDeviceCaps function. This is called the *logical resolution* of the device.

For printers, the normal resolution and the logical resolution are identical (ignoring rounding errors). For video displays, however, the logical resolution is higher than the normal resolution. For example, using the above formulas for a VGA monitor gives you a normal resolution of about 68 dots per inch, while the logical resolution is 96 dots per inch.

The difference is dramatic. Say you're

working with a 12-point font, which is 1/6 inch high. Assuming a normal resolution of 68 dots per inch, the full height of the characters works out to about 11 pixels. With a logical resolution of 96 dots per inch, it's about 16 pixels—an increase of about 45 percent!

Why the difference? If you think about it, there is no true resolution of a VGA display. A standard VGA displays 640 by 480 pixels, but the size of the actual screen may range from a tiny notebook computer to a wall-size projection. Windows itself has no way to determine the actual screen size. The HORZSIZE and VERTSIZE values are based on a "standard" desktop VGA screen size, probably one of the early IBM models that some anonymous Microsoft programmer measured with a ruler back in 1987.

In any case, you really don't want fonts displayed on the screen in their true size. Suppose you're using a VGA projector in a presentation before hundreds of people, and you display 12-point fonts that actually measure 1/6th inch on the projection screen. There are better ways to confuse your audience.

People using word processors to output text usually do so on 8.5- by 11-inch paper (8 by 10 inches, considering margins). Since most VGA displays are wider than 8 inches, it makes better use of the screen real estate to display larger characters based on the logical resolution. And while a 12-point font may read fine on paper, it might seem too small on a video display. Also, compared with laser printers, video displays do not have a very high resolution, which also affects readability. Larger text on the screen helps.

(As a historical note, the logical screen resolution was devised in part to make the design of raster fonts easier. The logical resolution is set to provide a convenient integral relationship between pixels and points. For example, with 96-dpi resolution, there are 4 pixels for every 3 points.)

Have I convinced you that you should be using logical resolution rather than the normal resolution for sizing fonts? I hope not, because I haven't convinced myself. Using the logical resolution introduces a problem, particularly if you're mixing text with graphics.

As I discussed in a previous column, the SetMapMode function lets you use

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logical coordinates that are based on fractions of inches or millimeters in GDI graphics functions. However, GDI uses the normal resolution of the device (based on the information available from `GetDeviceCaps`) rather than the logical resolution to set up the window/viewport transform that results from the `SetMapMode` function.

This means that if you use the `SetMapMode` function to draw graphics in units of inches or millimeters, and you use the logical-device resolution for sizing fonts, you'll run into inconsistencies. You won't see inconsistencies with printer output—normal resolution and logical resolution are identical—but on the video display, where there's a 45 percent difference.

So should we use normal resolution or logical resolution? Let's avoid making a commitment by adding yet another parameter to the `EzCreateFont` function in order to specify one or the other. Then the decision will be left to the particular application or even to the user. In either case, I'll demonstrate in a future issue how to avoid possible mapping-mode inconsistencies.

No matter how you calculate dots per inch, you can determine the pixel height of a font (using variables introduced earlier) with the formula

$$cyPixels = cyDeciPts \times cyDpi / 72$$

Actually, because we're using decipoints here, the value of `cyPixels` will be 10 times larger than it should be. We'll adjust later for this extra magnitude of precision.

THE COORDINATE CONVERSION The `LOGFONT` structure you pass to `CreateFontIndirect` requires a font height in logical units. Once you have the value of `cyPixels` obtained above, getting logical units would seem to involve a fairly simple call to the `DPTOLP` (device point to logical point) function. Not so fast: More complications await.

In order for the `DPTOLP` conversion to work correctly, the same mapping mode must be in effect when you later display text using the created font. This means that you should set the mapping mode before calling the `EzCreateFont` function. In most cases, you use only one mapping mode for drawing on a particular area of

the window, so this requirement shouldn't be a problem.

The world transform, on the other hand, is a whole other issue. As you know from the last issue, the conversion from logical coordinates to device coordinates requires first the world transform and then the window/viewport transform. You set the former with the `SetWorldTransform` function and the latter with the `SetMapMode` function. The `DPTOLP` conversion in our `EzCreateFont` function,

however, should not involve the world transform. The world transform can be used later to scale a particular font along with other graphics.

Here's an example: Suppose you want to display a 12-point font with a particular map-

ping mode. The `EzCreateFont` function should be able to set up a `LOGFONT` structure with the proper height in logical coordinates, and you've already seen how to do that. With no world transform in effect, that font should always appear 12 points high in that mapping mode. But if you set a world transform to scale coordinates by a factor of 2, you'd want the font to appear 24 points high. If that particular world transform was in effect at the time of the `DPTOLP` conversion in `EzCreateFont`, the conversion would include the world transform, and the font would still be 12 points high.

Although the window/viewport transform and the world transform both involve conversions from logical coordinates to device coordinates, you use the two transforms in very different ways. Use the window/viewport transform to draw in units of inches, millimeters, or whatever unit of measure you prefer. Use the world transform to translate, scale, shear, or rotate graphics objects. In this way, the world transform provides zoom-in and zoom-out capabilities for fonts.

In a nutshell, here's the procedure: First, set your mapping mode and (if necessary) alter the window and viewport extents and origins. Then create the font. Finally, use the world transform to scale, shear, or rotate the font.

*The world transform
can provide zoom-in
and zoom-out capabilities
for fonts.*

THE EM-WIDTH PROBLEM Now, just when you thought it was safe to write an `EzCreateFont` function, another problem arises. The original prototype of the `EzCreateFont` function included the parameter `cxDeciPts`. This is the em-width of the font. The em-width is not a real font metric. If the point size of a font is 12, then an em-width of 12 gives you characters that appear normal—just as the font designer intended. If the em-width is 6, the characters are half the width and appear

condensed, while an em-width of 24 displays characters that are double the normal width.

The problem is that the `LOGFONT` structure you pass to `CreateFontIndirect` does not include a field for the em-width. The `lfWidth` field of this structure indicates the average width of the characters in the font you're requesting. Normally, if you set this field to 0, you'll get a normal width based on the font height. But we'd like the ability to set a different em-width. Unfortunately, the em-width is just not the same as the average character width.

The implication for our `EzCreateFont` function is that you must first create a font based on a normal character width by setting the `lfWidth` field of the `LOGFONT` structure to 0. Select that font into the device context. Then use the `GetTextMetrics` function and a structure of `TEXTMETRIC` to obtain the average character width of the created font. The structure field is `tmAveCharWidth`. Scale that value by the ratio of the requested em-width to the requested em-height. Then create a new font with this adjusted average width value. Deselect the first font from the device context and delete it.

Although this process is a real hassle, it's the only real solution to the problem. The font-handling functions in Windows were designed for an earlier age of raster fonts, not for typographically correct TrueType outline fonts. In the next Environments, I'll unveil the amazing `EzCreateFont` function and begin putting it through its paces. □



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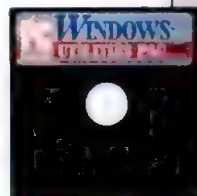
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Utilities

BY DOUGLAS BOLING

Switch Windows Setups with Switcher

The personal computer is an integral part of today's modern family. Whether Dad uses it to prepare the taxes, Mom uses it to prepare for tomorrow's meeting, or Junior uses it to do his homework, the home computer has become less a personal computer and more a family computer. The problem is that everyone has his own style of working. Under Microsoft Windows, the variations are virtually countless. From lighting-fast mice to flashy backgrounds, today's Windows desktop is an extension of the person using it.

So what happens when the family computer meets the personalized desktop? Usually an argument! Junior's speedy mouse setting can make Windows unusable for Dad. Sure, most of these settings can be individually changed using Control Panel, but it can be a real pain to change all the settings every time you sit down in front of the computer. This issue's utility, Switcher, makes changing the configuration simple.

Switcher saves up to 16 different Windows 3.1 configurations and allows access to those configurations with the click of a button. Switcher saves the desktop colors, the screen savers, the mouse settings, the keyboard speeds, and a number of other configurable items. To create a configuration, adjust the settings using Control Panel, and then ask Switcher to create a button for that configuration. From then on, your favorite configuration is a mouse click away.

Acquiring your own copy of Switcher is almost as easy as using it. The program and its C language source code can be obtained, either by mail or by downloading the files from our on-line service, PC MagNet. Look for the file SWITC.ZIP in the Utilities/Tips Forum. Refer to the sidebar "Guide to Our Utilities & How to Get Them" for details.

USING SWITCHER You can launch Switcher from the File | Run item on the Program Manager menu, but since you'll be using Switcher often, you're better off creating a Program Manager icon for it. That way you can start Switcher with a double click. You may even want to put Switcher in your Startup group.

When you first use Switcher, you will need to create a set of buttons—one for

each configuration you want to save. A list of the settings that Switcher can save and restore is shown in Figure 1. The list also shows where each of the items is changed manually.

Once you have Windows configured the way you want, start Switcher and select the Buttons | Add New Button menu item. Switcher will present a dialog box for entering the button name and some extra configuration preferences. You must enter a name for your button; the other fields (Startup program, Cleanup program, and Resave on Switch) are optional.

The Startup program field lets you enter a program to be launched when the button is clicked. The Cleanup program field is for specifying a program to be run when the setup is changed by another button. These Startup and Cleanup programs can be script files for batch-program utilities, such as WinBatch or my own WIN-CMD. Using a script lets more than one program be run at the start or end of a session. Note that although Switcher launches the Startup and Cleanup programs, it does not wait for the programs to load before configuring (or reconfiguring) the machine.

Finally, you can elect to have your configuration automatically resaved any time another configuration is selected. This feature, Resave on Switch, lets Switcher automatically record any changes you have made to your configuration. When this feature is not enabled, the setup for a button will remain as it was originally configured, regardless of changes you make to the desktop later. Switcher is able to track which configuration button is active and will save changes only to the active button.

Once you have entered the configuration information, click the OK button. Switcher will save that configuration in a file called SWITCHER.DAT, located in the same directory as SWITCHER.EXE. You will then see a button with your title in the Switcher window.

Of course, having only one button and therefore one configuration saved does not really help much. The power of Switcher can be seen only when you add more buttons. Before you add the next button, configure Windows to suit the next user. Then select the Buttons | Add

Top 10 Utilities

Rank	Utility
1	BAT2EXEC - Compiles batch files
2	MBOOT - Multiple boot program
3	FINDIRQ - Locates available IRQs
4	MONITOR - Monitors system resources
5	DIRMATCH - Displays directories side by side
6	BUGS - Windows 3.1 screen saver
7	INCTRL - Controls Windows' installation
8	WTIME - Keeps PC clock accurate
9	EMS40 - Converts extended memory
10	CLIPSTAC - Enhances Windows Clipboard

This list is based on the total number of downloads each utility has had on PC MagNet over the past 12 months. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "Guide to Our Utilities & How to Get Them."

Settings Saved by Switcher

Settings saved by Switcher	Control Panel applet where manually adjusted
System sounds active	Sounds
Sizeable border width	Desktop
Desktop placement grid granularity	Desktop
Icon spacing	Desktop
Icon title wrap	Desktop
Wallpaper	Desktop
Screen saver	Desktop
Screen saver time-out	Desktop
Desktop pattern	Desktop
Keyboard repeat delay	Keyboard
Keyboard repeat rate	Keyboard
Desktop colors	Colors
Mouse speed	Mouse
Mouse button swap	Mouse
Mouse double-click speed	Mouse
Mouse acceleration profiles	Mouse (Microsoft Version 9.0 only)
Mouse orientation angle	Mouse (Microsoft Version 9.0 only)

Figure 1: The Microsoft Windows settings that Switcher can save are all manually set through Control Panel applets.

New Button menu item again and fill in the dialog box for the new button. When you click OK, you will see two buttons in the Switcher window.

Now, to see how Switcher works, click on the original button. You will see the Windows desktop change back to the setup defined by the first button. Clicking on the second button will return the desktop to the second setup. The changes are dramatically visible if the two setups have different color settings. Even if the differences aren't visible, however, the other configuration items have also been changed.

If you want to change the settings of a particular button, select the Buttons | Edit Button menu item. A list of the buttons will be presented so that you can select the button that you want to edit. Once you have selected a button, a dialog like the one originally used to add the button will be presented with the current information already filled in so that you can make your changes. When you save this edited configuration by clicking OK, Switcher will record the configuration using current settings. If you like the desktop settings the way they are but want to change the Startup and Cleanup programs, be sure to switch

to your configuration *before* editing the button settings.

To delete a button, select the Buttons | Delete Button menu item. A list of the buttons will be presented. Select the button you want to delete from this list, and when you click on OK, the button will be deleted.

You can control the appearance of the Switcher buttons through the Switcher | Configure menu. By default, Switcher presents the buttons in a single horizontal row.

The Configure dialog lets you select vertical or horizontal alignment and lets you tell Switcher how many rows or columns to use. You can also tell Switcher to hide its menu and status bar so that it takes up less space on the desktop. When the pull-down menu is not displayed, the menu can be accessed through the system menu.

The Switcher | Exit menu item closes Switcher. When Switcher terminates, the setup for the last button remains in effect. If Resave on Switch is enabled for that button, the current desktop settings will be recorded when either you change configurations or Switcher terminates. The last menu item, Help | About, displays the About box dialog with the standard copyright information.

INSIDE SWITCHER Switcher uses only a handful of system calls. For the most part, it was straightforward to program, but I encountered one major snag. I'll describe the easy part first. A Microsoft Windows API function called SystemParametersInfo() can be used to query and set many of the parameters that Switcher saves. Figure 2 shows the syntax for the SystemParametersInfo() call and the items that can be set and queried.

When you call SystemParametersInfo(), you pass four parameters: the value

to set or to query, two variables whose contents depend on the function to be performed, and a flag that describes how the system should be notified of any changes. For example, to query the current keyboard repeat rate, the SystemParametersInfo() function would be called with the syntax

```
SystemParametersInfo(SPI_GETKEY-  
BOARDSPEED, 0, lpwKeySpeed, 0);
```

where lpwKeySpeed is a far pointer to the WORD variable that holds the current keyboard speed value. The function returns a nonzero value if successful. To set the keyboard speed to a different value, use the syntax

```
SystemParametersInfo(SPI_SETKEY-  
BOARDSPEED, wKeySpeed, 0, SPIF_UP-  
DATEINIFILE | SPIF_SENDWININICHANGE);
```

Notice that when you set the keyboard speed, the new value is passed in the generic word parameter instead of in the generic long parameter (as is the case when querying the value). The two generic parameters for the call are used differently for almost all the actions SystemParametersInfo() performs.

The two update flags, SPIF_UPDATEINIFILE and SPIF_SENDWININICHANGE, tell Windows how to notify other applications of the change. When the SPIF_UPDATEINIFILE flag is set, the field in the WIN.INI file that contains the keyboard speed value will be updated to match the new value. If this flag isn't set, the WIN.INI field will not be updated and the old value will be used the next time Windows is started. The SPIF_SENDWININICHANGE flag indicates that a WM_WININICHANGE message will be sent to all top-level windows after the .INI file has been updated. Windows checks this flag only if the SPIF_UPDATEINIFILE flag is set.

One problem with SystemParametersInfo() is that not all its features have matched Get and Set calls. For example, the SPI_SETDESKWALLPAPER feature is not matched with another one that gets the current wallpaper setting. In order to get around this problem, a program must read the parameter from the [desktop] section of WIN.INI. De-

The SystemParametersInfo() Function

```
BOOL SystemParametersInfo(uAction, uParam, lpvParam,
fuWinIni)
```

```
UINT uAction;      // system parameter to query or set
UINT uParam;      // depends on the uAction parameter
void FAR* lpvParam; // depends on the uAction parameter
UINT fuWinIni;    // WIN.INI update flag
```

Value of uAction	Meaning
SPI_GETBEEP	Retrieves a BOOL value that indicates whether the warning beep is on or off.
SPI_GETBORDER	Retrieves the border multiplying factor that determines the width of a window's sizing border.
SPI_GETFASTTASKSWITCH	Determines whether fast task switching is on or off.
SPI_GETGRIDGRANULARITY	Retrieves the current granularity value of the desktop sizing grid.
SPI_GETICONTITLELOGFONT	Retrieves the logical font information for the current icon-title font.
SPI_GETICONTITLEWRAP	Determines whether icon-title wrapping is on or off.
SPI_GETKEYBOARDDELAY	Retrieves the keyboard repeat-delay setting.
SPI_GETKEYBOARDSPEED	Retrieves the keyboard repeat-speed setting.
SPI_GETMENUDROPALIGNMENT	Determines whether pop-up menus are left-aligned or right-aligned relative to the corresponding menu-bar item.
SPI_GETMOUSE	Retrieves the mouse-speed and mouse-threshold values, which Windows uses to calculate mouse acceleration.
SPI_GETSCREENSAVEACTIVE	Retrieves a BOOL value that indicates whether screen saver is on or off.
SPI_GETSCREENSAVETIMEOUT	Retrieves the screen-saver time-out value.
SPI_ICONHORIZONTALSPACING	Sets the width, in pixels, of an icon cell.
SPI_ICONVERTICALSPACING	Sets the height, in pixels, of an icon cell.
SPI_LANGDRIVER	Forces the user to load a new language driver.
SPI_SETBEEP	Turns the warning beep on or off.
SPI_SETBORDER	Sets the border multiplying factor, which determines the width of a window's sizing border.
SPI_SETDESKPATTERN	Sets the current desktop pattern to the value specified in the Pattern entry in the WIN.INI file or to the pattern specified by the lpvParam parameter.

SPI_SETDESKWALLPAPER	Specifies the filename that contains the bitmap to be used as the desktop wallpaper.
SPI_SETDOUBLECLKHEIGHT	Sets the height of the rectangle in which the second click of a double click must fall in order to be registered as a double click.
SPI_SETDOUBLECLICKTIME	Sets the double-click time for the mouse. The double-click time is the maximum number of milliseconds that may occur between the first and second clicks of a double click.
SPI_SETDOUBLECLKWIDTH	Sets the width of the rectangle in which the second click of a double click must fall in order to be registered as a double click.
SPI_SETFASTTASKSWITCH	Turns fast task switching on or off.
SPI_SETGRIDGRANULARITY	Sets the granularity of the desktop sizing grid.
SPI_SETICONTITLELOGFONT	Sets the font that is used for icon titles.
SPI_SETICONTITLEWRAP	Turns icon-title wrapping on or off.
SPI_SETKEYBOARDDELAY	Sets the keyboard repeat-delay setting.
SPI_SETKEYBOARDSPEED	Sets the keyboard repeat-speed setting.
SPI_SETMENUDROPALIGNMENT	Sets the alignment value of pop-up menus.
SPI_SETMOUSE	Sets the mouse speed and the x and y mouse-threshold values.
SPI_SETMOUSEBUTTONSWAP	Swaps or restores the meanings of the left and right mouse buttons.
SPI_SETSCREENSAVEACTIVE	Sets the state of the screen saver.
SPI_SETSCREENSAVETIMEOUT	Sets the screen-saver time-out value.

The parameter fuWinIni specifies whether the WIN.INI file is updated when changes are made. If so, it also checks whether the WM_WININICHANGE message is broadcast to all top-level windows to notify them of the change. This parameter is a combination of the following values:

Value of fuWinIni	Meaning
SPIF_UPDATEINIFILE	Writes the new systemwide parameter setting to the WIN.INI file.
SPIF_SENDWININICHANGE	Broadcasts the WM_WININICHANGE message if the WIN.INI file is updated. This flag has no effect if SPIF_UPDATEINIFILE is not specified.

Figure 2: The SystemParametersInfo() function, whose syntax is reprinted here from the Microsoft Windows SDK, queries or sets the systemwide parameters used by Switcher. The return value is nonzero if the function is successful and 0 if the function is unsuccessful.

BOOTTIME.BAT

```

INT GetSetMouseData (lpMouseData, dwAction);

LPMOUSEDATA lpMouseData          //Far pointer to MOUSEDATA structure
DWORD dwAction                    //DWORD indicating action to perform

typedef struct {
    BYTE bButtonType;              //1-Bus, 2-Serial, 3-InPort 4-PS/2
    BYTE bData2;                   //Unknown
    LPVOID lpNewMouseFunc;          //Pointer to new mouse event proc
    INT sMouseVer;                  //MOUSE.DRV version
    INT sMouseOrientation;          //Mouse orientation
    UINT usMouseBtnAssign;          //Mouse-button assignments
    BYTE bData7;                   //Unknown
    UINT usMouseSpeed;              //Byte values for x any y sensitivity
    BYTE bData9;                   //Related to acceleration-table names
    LPBYTE lpAccelTbl;              //Pointer to acceleration-table data
    LPBYTE lpAccelNames;            //Pointer to acceleration-table names
    BYTE bAccelActive;              //Indicates active accel table
    LPSTR lpszProfileName;          //Pointer to buffer for profile name
} MOUSEDATA;
typedef MOUSEDATA far * LPMOUSEDATA;

-----
Actions                                DWORD value
-----
GetButtonType                          0x0002
GetData2                              0x0004
XchgProc                              0x0008
GetMouseVersion                        0x0010
GetSetOrientationAngle                 0x0020
GetSetButtonAssignments                0x0040
GetSetData7                           0x0080
GetSetMouseSensitivity                 0x0100
GetSetAccelTblNameVal                  0x0200
GetSetAccelTblData                     0x0400
GetSetAccelTblNames                    0x0800
GetSetActiveAccelTbl                  0x1000
GetSetActiveAccelTbl                   0x2000
GetProfileFilename                     0x4000

```

Figure 3: The GetSetMouseData() function, exported from MOUSE.DRV, lets you change settings in Version 9.0 of the Microsoft mouse driver that can't be changed through a standard SystemParametersInfo() call. Note that if the least-significant bit of the DWORD value is clear, the function returns the value. If this bit is set, the value is written to the mouse driver.

terminating the desktop pattern and screen saver also require reading .INI files. Some items, such as the mouse double-click parameters, must be queried using the GetSystemMetrics() function.

AN UNDOCUMENTED MOUSE CALL SystemParametersInfo() was added in Microsoft Windows 3.1 to provide a programmatic interface for setting and changing system parameters. But not every function works as claimed—notably the mouse functions.

Microsoft's new "humpbacked" mouse was bundled with a new mouse driver—Version 9.0. The problem is that this new driver does not use the profile settings in WIN.INI when it initializes. Not only are the parameters in WIN.INI ignored, SystemParametersInfo() calls for setting the mouse speed and the button-swap setting have no effect on the configuration of the mouse. To control the new

mouse, another method must be used.

The function GetSetMouseData() is exported from the mouse-driver DLL, MOUSE.DRV. This function, which I have not seen documented anywhere, provides a method to get and set the mouse-configuration values used by the Version 9.0 driver. Interestingly, this call is exported—with the same name and functionality—from the mouse driver that originally shipped with Windows 3.1, but it does not seem to have been used by the standard Mouse Control Panel applet.

Figure 3 shows the syntax I have been able to decipher for GetSetMouseData(). The call is made with two parameters, a pointer to a structure I call MOUSEDATA and a double-word value that indicates the desired action for the call. The double-word value is a bit field that tells the function what data fields in the MOUSEDATA structure to

act on. For each action requested, the function either reads a value from the MOUSEDATA structure or writes the value from the mouse driver to the structure. The least-significant bit of the double-word action parameter indicates whether the parameters should be set or queried.

To set a value, place the data or a pointer to the data (in the case of the tables) in the proper item in the structure. Then call GetSetMouseData() with the bit for that data item set and set the least-significant bit to indicate the function should write the new data. More than one data item can be written per call: Just place all the data items in the structure and call the function with the bits for all of these data items set.

To query a value, just set the proper bits in the data structure and call the function. The mouse driver will fill the structure with the requested data. For the GetAccelerationTable, GetAccelerationTableName, and GetProfileFilename actions, the fields in the structures must be filled with pointers to buffers large enough to hold the data. In the case of the GetProfileFilename action function, the first byte of the field should be initialized with the length of the buffer.

Most of the settings that can be queried or set using the GetSetMouseData() function are familiar to anyone who has programmed the mouse driver under DOS. The ability to program the acceleration profiles and set the orientation of the mouse (left and right button assignments as well as horizontal and vertical orientations of the mouse itself) are new functions for Windows programs. Some items cannot be set—for example, the mouse type and driver version number. If you try to set these items, the function returns an error code. The final action, GetProfileFilename, is handy for locating the mouse-profile file, which may not reside in the Windows directory.

Figure 4 shows an example that uses GetSetMouseData() to query both the driver version and the .INI filename of the mouse driver. Notice that the routine uses LoadLibrary() and GetProcAddress() to determine the address of the GetSetMouseData() function. An alter-

An Example Using GetSetMouseData()

```

LPMOUSEFUNC lpfnGetSetMouseData;
HINSTANCE hMouseLib;
MOUSEDATA mdData;
char szProfName[128];

hMouseLib = LoadLibrary ("MOUSE");
if (hMouseLib > 32) {
    lpfnGetSetMouseData = (LPMOUSEFUNC)GetProcAddress (hMouseLib,
        "GetSetMouseData");
    if (lpfnGetSetMouseData) {

        //First set the length of the buffer in the first byte
        szProfName[0] = (char) sizeof (szProfName);

        //Set pointer in MOUSEDATA to buffer
        mdData.lpszProfileName = (LPSTR)&szProfName;

        //Call the function
        (*lpfnGetSetMouseData)(&mdData, 0x4010);

        if (mdData.sMouseVer >= 900h) {
            //Do something
        }
    }
    FreeLibrary (hMouseLib);
}

```

Figure 4: This routine uses GetSetMouseData() to query both the driver version and the .INI filename of the mouse driver.

native approach would be to define GetSetMouseData() as an import in the .DEF file. One of these two methods for explicitly linking the function is necessary, since GetSetMouseData() is not part of the standard Windows library modules.

The GetSetMouseData function allows greater control over the mouse than simply using the SystemParametersInfo() function. But it's not the additional control that makes GetSetMouseData() worthwhile, it's the fact that Version 9.0 of the Microsoft mouse driver ignores the values controlled by SystemParametersInfo().

Once all the calls for querying and setting the configuration items are found, switching among configurations is relatively straightforward. Switcher reacts to a button press by running any Cleanup program the user has requested, saving the current Windows settings if Resave on Switch is enabled, setting the new configuration, and finally executing the Startup program for the new configuration.

THE SWITCHER WINDOW The remainder of the Switcher code is fairly standard Windows fare. The buttons on the window are child windows of the standard button class with push-button style. To conserve valuable desktop real estate, the

Switcher window resizes itself to be as small as possible while still fitting all its buttons. When a user creates or deletes a button or changes the Switcher configuration, Switcher deletes all the button windows, and then re-creates them in the new arrangement according to the settings in the Configuration dialog box. The window is then resized to fit snugly around the buttons.

In order to size the window properly, Switcher needs to know the dimensions of the frame controls that surround the client area of the window. The client area is the white space where a Windows program usually displays its data or places child windows. You can determine the frame-control dimensions with the Windows' GetSystemMetrics() call. Typically, the vertical height includes the heights of the title and menu bars as well as the height of the window's horizontal borders. When the menu doesn't wrap around to a second line, this height can be computed with the following simple equation:

```

sFrameHeight = GetSystemMetrics(SM_
CYCAPTION) + GetSystemMetrics (SM_
CYMENU) + 2 * GetSystemMetrics(SM_
CYBORDER);

```

Note that the call GetSystemMetrics(SM_CYBORDER) returns the height of an unsizeable window border. If the window has a sizeable border or a Dialog Frame border, the calls would be GetSystemMetrics(SM_CYFRAME) and GetSystemMetrics(SM_CYDLGBORDER), respectively.

A problem arises when the window width is narrower than necessary to display the menu text on one line. When this happens, Windows wraps the menu to two or more lines, doubling the height of the menu, which completely invalidates the frame height we just computed!

While there are many ways to solve this problem, Switcher solves it by measuring the height of the menu. To do this, Switcher gets the position of the window relative to the upper-left corner of the screen by using GetWindowRect(). Then the client window rectangle is queried using GetClientRect(). Since the rectangle returned by GetWindowRect() is measured from the upper-left corner of the screen and the client rectangle is referenced from a point just below the menu, the difference between the two points can be used to determine the height of the border, caption, and menu all in one shot!

Before trying this technique, however, you should take the time to examine the fine print on the GetClientRect() and GetWindowRect() calls. As I mentioned earlier, GetWindowRect() returns values relative to the upper-left corner of the screen, while GetClientRect() returns values relative to the client window. Before the values can be compared, they must be based on the same coordinate system. Fortunately, Windows provides the solution with two calls, ClientToScreen() and ScreenToClient(), that switch between the two systems. In our case, the upper-left corner of the client window is always 0,0, so we can discard the call to GetClientRect(). We just convert the client coordinates 0,0 to screen coordinates, and then compare this result to the coordinates of the upper-left corner returned by GetWindowRect(). The difference between the two points is the height of the caption and menu, which can then be used to compute the proper size of the window.

One area where Switcher departs from standard Windows programming practice is in its use of a data file (SWITCHER.DAT) rather than a standard Windows .INI file to store configuration information. The reason is the large amount of data that Switcher needs to save. Using an .INI file, Switcher would have to make a Windows call to read each and every item of data for up to

16 buttons. Instead, Switcher simply writes all the information to its data file in one fell swoop. Since the configuration file is updated at every button press—not only when Switcher starts or ends—response time is improved.

Switcher is a simple program with a big goal: to promote peace in the modern computer-centric family. For programmers, Switcher demonstrates that you

can build a useful utility with only a few carefully planned calls to the Windows API. And in light of the problems with the new Microsoft mouse driver, Switcher also demonstrates that not everything about Windows programming is in the manual. □

DOUGLAS BOLING IS A CONTRIBUTING EDITOR OF PC MAGAZINE.

GUIDE TO OUR UTILITIES & HOW TO GET THEM

SWITCHER

PURPOSE: Switcher lets multiple users work harmoniously on the same computer by saving and providing quick access to individual Microsoft Windows 3.1 configurations. Switcher can save and restore such settings as wallpaper, mouse speed, button configurations, and screen saver.

SETUP: To install Switcher, simply copy it to a directory on your hard disk. Then choose File | New in Program Manager, select Program Item, and specify the path and filename for Switcher. Then double-click on the icon to load the program.

Use the Windows Control Panel to configure Windows the way you want, and then select Add New Button from Switcher's Buttons menu. You will be prompted for a button name and some optional information.

To create additional buttons, go through the same process again. Reconfigure Windows using Control Panel, select Buttons | Add New Button, and then give the new button a name. To switch configurations, simply click the desired button.

REMARKS: The optional fields in the Add New Button dialog box are Startup program, Cleanup program, and Resave on Switch. The Startup program is launched when the button you are configuring is clicked; the Cleanup program is launched when a different button is clicked. Both programs can be script files for Windows batch-program utilities, such as WinBatch or WINCMD.

With the Resave on Switch option enabled, Switcher will resave your button settings any time a configuration change is made. When this feature is not enabled, the setup for a button will remain as it was originally configured, regardless of later changes to the desktop.

Switcher stores configuration information in a file called SWITCHER.DAT, which is located in the same directory as SWITCHER.EXE.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

Hardware

TOWERING INFERNO?

❓ I'm trying to decide on a tower case for my new 486DX/50 system, which includes three floppy disk drives, one hard disk, a CD-ROM drive, an internal modem, and lots of memory. I've been told that I should be concerned about adequate cooling. I realize I can add a fan to cool the 486 chip, but do I need to worry about the other components?

*Edward H. Carter
Westlake Village, California*

► **PC MAGAZINE:** When configured with reasonable care and maintained properly, few (if any) of the tower cases available on the market today should give you cause to worry about overheating. The tower cases that are sold separately are often the same ones used by systems vendors, who can hardly afford to replace a large number of systems that fail because of overheating.

On some of the larger tower cases, the cooling fans are controlled by a thermocouple, which regulates the airflow speed based on the temperature inside the case. (This is usually done in an effort to reduce the fan noise, since the fans make less noise when they turn at a lower speed.) In my experience testing such units, I've rarely noticed any of these machines raising the fan speed above the lowest level, even after hours on the test bench.

Certainly, adding a cooling fan specifically for the CPU can do no harm, and for the \$20 or \$30 that it costs, it might be a reasonable insurance policy. There are also supplemental fans (such as muffin fans, which attach to vents in the case or are mounted on an expansion card) that you can add to a system if you decide it

needs more airflow. I suspect, though, that these will not be required with your configuration.

You should certainly maximize the airflow within the case by leaving empty slots (if you have any) between boards and by alternating long and short boards. If you have one board that seems to generate more heat than the others, put it at the end. And be sure that dust and debris do not build up or block the flow of air within the case.—*Alfred Poor*

EXCEEDING THE SPEED LIMIT

❓ My new 486DX is configured to run at 80MHz. My problem is that after setting the time and date, the clock loses 5 minutes during the next 10 minutes and hours overnight. My computer consultant tells me the problem is inherent in these very fast machines and that nothing can be done about it. Is he right?

*Charles Pegler
Islandia, New York*

► **PC MAGAZINE:** Your consultant is right, but he hasn't told you the whole story. Your "very fast" machine's speed has been achieved by ignoring component ratings. There are no 80-MHz 486DX chips on the market, and I don't know of

any motherboards designed to operate correctly at that speed.

The consultant (or whoever configured the system) has apparently used the motherboard's ability to select different CPU speeds to set the chip's speed at 80MHz—faster than it is designed to run. (The maximum rated speed for the CPU should be marked right on the chip as a two-digit number following the model number. An Intel 80486DX/33 is rated at 33MHz and an AMD AM486DX/40 is rated at 40MHz, for example.)

I'd guess you have a 40-MHz AMD CPU that is being pushed to twice its maximum rated speed. This increases the amount of heat generated by the chip. Moreover, the manufacturer does not guarantee the chip's reliability at this speed. What makes your story different from the typical pushed-CPU story is the misbehavior of the system clock. I don't know exactly why your clock is running at half speed, but I suspect that it's related to the doubling of the CPU speed. To experiment, have the consultant reconfigure the motherboard to provide the CPU speed that matches the chip's maximum rating and see whether the clock problem disappears. If so, your choice must be between a supercharged computer and one that can tell time correctly.—*Alfred Poor*

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FULL-SIZE PRINTING

❓ Why does no one ever write about print-area limitations when reviewing printers' features? I am thoroughly disappointed with my new ink jet printer, because I can't print a document longer than 9.75 inches on a regular sheet of paper. This is a major problem for programs that expect to fit more than that on a page. Is there any way to increase the size of the print area?

Arthur W. Cossaboom
Appleton, Wisconsin

► **PC MAGAZINE:** Since there must be some mechanism that grabs and then pushes or pulls the sheet through the printer's imaging system, every printer that handles cut-sheet paper will have limitations on how close to the edges it can print—especially at the top. This limitation almost never applies to the bottom of the page, however, and therein may lie the solution to your problem. Tell your printer it has longer pages, and you may be able to print larger images.

The first thing to check is whether the printable area is being affected by the printer's default margin settings. Most

printers default to margins that match the maximum printable area. To be certain, however, consult your printer manual and, if necessary, send the printer commands that will give you the smallest possible margins.

Many printers base their default top- and bottom-margin settings on paper size, however, and you may not be able to reset the margins beyond certain limits. In that case, you can often trick the printer into thinking it has a longer sheet of paper than it really has. Configure your software for legal-length pages but design the image (or set the margins) so that the

printed area remains within the limits of a letter-size sheet. In many cases, this will let you fit more on the page.

One word of warning: This technique may make it possible to create a bottom bleed in which the image runs off the end of the page. If you want to create this effect, fine—but don't use letter-size sheets, or you may get ink sprayed around the inside of your printer. (The paper-out sensor should prevent this from occurring, but why ask for trouble?) Instead, use a legal-length page, and then trim it down to letter size after the image has been printed. With careful juggling, you can use this technique to create a top and bottom bleed with your printer. Note that this method can also be used with laser printers.—*Alfred Poor*

Our Advisors

Douglas Boling is a contributing editor and the author of many utilities, including MBOOT.COM and EMS40.SYS.

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HOW TO CONTACT US

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Operating Environments

CAPITALIZING COMMAND LINE ARGUMENTS

❓ A programmer's magazine once set out to find a new staff writer. As part of the process, the editor asked each candidate to write and debug a short program called REVERSE. The program had to accept a number of command line arguments and print them in reverse order and in upper-case. Thus the command REVERSE hike a take should print REVERSE: TAKE A HIKE. This is a true story, and the successful applicant was employed!

But you don't need a programming language for this. All you need are DOS's internal commands, as REVERSE.BAT

(Figure 1) shows. This "program" works fine with all versions of DOS 3.3 or higher. DOS 5.x and 6.x are even able to capitalize the European characters æ, å, å, Ç, é, ñ, ö, and ü. But is there any means for capitalizing command line arguments in DOS *other* than by changing the path?

Olavi Kanervisto
Vähikkälä, Finland

► **PC MAGAZINE:** DOS's PATH command sets the path environment variable to the list of directories you specify *and* converts the list to uppercase. Batch files such as REVERSE.BAT use this feature to convert strings to uppercase. The question is can we find other occasions in which DOS automatically capitalizes strings?

REVERSE1.BAT (Figure 2) takes advantage of the fact that DOS capitalizes filenames. The batch file starts by creating and switching into an oddly named temporary directory. Then for each command line argument, it creates a batch file with that argument as its filename. The line

REVERSE.BAT

Complete Listing



```
@ECHO OFF
SET savepath=%path%
SET oldprompt=%prompt%
REM All but the first of the spaces in the next
REM line are actually ASCII character 255.
PATH %0:~9~8~7~6~5~4~3~2~1
PROMPT %path%
ECHO ON

@ECHO OFF
ECHO.
PATH %savepath%
PROMPT %oldprompt%
IF (%1)==( ) ECHO SYNTAX: reverse word1 word2 [word..] (max. 9 words)
```

Figure 1: REVERSE.BAT reverses the order of up to nine command line arguments and capitalizes them using the PATH command.

(right after the label *Loop*) that creates this temporary batch file is a veritable jumble of percent signs. DOS replaces the string %space% with the value of the environment variable named *space* and reduces the remaining three pairs of percent signs to a single percent sign apiece. The resulting line in the temporary batch file looks like this:

```
SET ucasename=%ucasename% %0
```

For the very first argument, there's no space before %0, because the e-var *space* is initially empty.

Next, REVERSE1 passes the output of the DIR command through the FIND filter and redirects the result into the batch file \$\$\$BAT. This batch file consists of a single line containing the directory entry for the first temporary batch file. When \$\$\$BAT gets executed, it runs the first temporary batch file, which has

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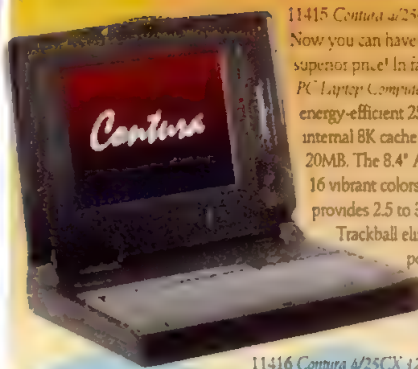


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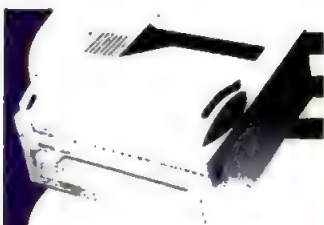
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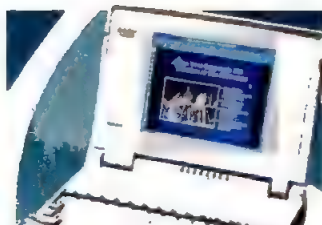
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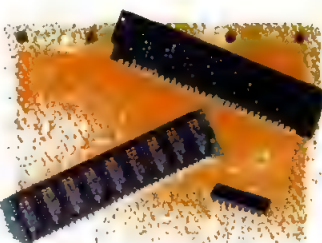
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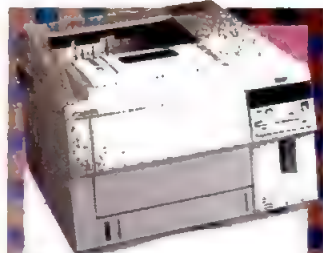
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REVERSE1.BAT

Complete Listing

```
@ECHO OFF
REM REVERSE1.BAT - reverses and uppercases its command line,
REM but truncates parameters to 8 characters each
MD TEMPZXQJ.$$$
CD TEMPZXQJ.$$$
SET ucasename=
SET space=
:===== Loop =====
ECHO SET ucasename=%~%space%~%ucasename%~%> %1.BAT
REM The space after the equals sign below is ESSENTIAL
SET space= > NUL
DIR %1.BAT | FIND /I "BAT" " " > $$$BAT
CALL $$$
SHIFT
IF NOT '%1'==' ' GOTO Loop
:=====
SET space=
DEL *.BAT
CD ..
RD TEMPZXQJ.$$$
ECHO %ucasename%
```



Figure 2: REVERSE1.BAT takes advantage of the fact that DOS capitalizes filenames to capitalize its command line arguments.

REVERSE2.BAT

Complete Listing

```
@ECHO OFF
REM REVERSE2.BAT - reverses and uppercases its command line
IF '%1'==' ' GOTO End
SET ucasename=
SET space=
:===== Loop =====
SET ucasename=%~%space%~%ucasename%
SET space= > NUL
SHIFT
IF NOT '%1'==' ' GOTO Loop
:=====
SET space=
REM ^[ in the next line represents the escape character
REM To enter this character in DOS 5's EDIT program,
REM press Ctrl-P, then the Esc key
SET %ucasename%=[^ID ^[[D
SET | FIND /I "%ucasename%"
SET %ucasename%=
SET ucasename=
:===== End =====
```



Figure 3: REVERSE2.BAT creates an environment variable whose name is composed of all its command line arguments. DOS automatically capitalizes this name.

the effect of prefixing a capitalized version of the current argument to the e-var *ucasename*.

After processing all of the command line arguments, REVERSE1.BAT cleans up by deleting the temporary files, removing the temporary directory, and clearing the e-var *space*. Finally, the batch file echoes the capitalized command line to the screen. This method has two limitations. First, all arguments will be truncated to eight characters, because that's the maximum length for a filename. Second, an argument that is also a DOS command will not be included in the output—try

REVERSE1 one for two.

REVERSE2.BAT, shown in Figure 3, takes a different approach. It builds a single environment variable that contains all the arguments from the command line in reverse order. Then it uses the resulting string as the *name* of a second e-var, because DOS automatically capitalizes e-var names. The *value* of this second e-var is an ANSI command that deletes the character to the left of the cursor. To display the result, the batch file passes the output of the SET command through the FIND filter, selecting only the line that contains the second e-var. Normally each line of

SET's output has the form NAME=value. In this case, the ANSI command contained in the value serves to *erase* the equal sign after the uppercase variable name! REVERSE2.BAT is faster than REVERSE1.BAT, because it avoids creating all those temporary files. (You can download all the batch files mentioned in this column from PC MagNet's Utilities/Tips Forum archived as REVER.ZIP.)

Now you know two more ways to capitalize command line arguments. I won't be surprised to find that still more possibilities exist!—Neil J. Rubenking



READING WINWORD 6.0 FILES IN WINWORD 2.0

TIP Given the care devoted to ensuring backward compatibility, it's no surprise that you can open a Microsoft Word for Windows, Version 2.0, file from Word for Windows, Version 6.0. Since the two versions of the program use different file formats, however, you'd probably never expect to be able to open a WinWord 6.0 file from WinWord 2.0. Rather, you'd expect only that WinWord 6.0 could save files in WinWord 2.0 format so that they could be opened by the earlier version.

You can in fact move files from WinWord 6.0 to WinWord 2.0 this way. But if you have both programs installed on the same system, you don't have to. Instead, when you're working in WinWord 2.0 and want to open a WinWord 6.0 file, just choose File/Open, highlight the WinWord 6.0 file you want to open, and choose OK. WinWord 2.0 will open the Convert File dialog box with the Word for Windows 6.0 choice highlighted. With WinWord, in short, you get forward compatibility too. WinWord 6.0 apparently modifies the WinWord 2.0 program during installation.

Shane Devenshire
Walnut Creek, California

► **PC MAGAZINE:** WinWord's forward compatibility is indeed a pleasant surprise that's easy to miss because you'd never think to look for it. However, WinWord

6.0 does *not* actually modify WinWord 2.0. Rather, both versions use external files to convert text and graphics. The files for WinWord 2.0 are identified in WIN.INI in the section [MSWord Text Converters]; those for WinWord 6.0 are listed in the [MS Text Converters] section of WINWORD6.INI and are stored, by default, in the WINDOWS\MSAPPS\TEXTCONV directory. (Note that you may also find references to additional conversion files in WINWORD6.INI. References in WIN.INI are for files that other Microsoft programs can also use; those in WINWORD6.INI are for files that only WinWord 6.0 can use.)

If you choose the complete installation option when installing WinWord 6.0 on a system that already has WinWord 2.0 on it, the installation routine will automatically add a reference to the WinWord 6.0 text-conversion file in the [MSWord Text Converters] section of WIN.INI. WinWord 2.0 can then use the text-conversion file. If you open WIN.INI, in fact, you'll also find a reference for text conversion for Microsoft Word for the Macintosh, Version 6.0, using the same file. The two lines, as added on my system, read as follows:

```
MSWord6=Word for Windows 6.0,
C:\WINDOWS\MSAPPS\TEXTCONV
\MSWORD6.CNV, doc
MSWord6Mac=Word for Macintosh 6.0,
C:\WINDOWS\MSAPPS\TEXTCONV
\MSWORD6.CNV, doc
```

And, of course, if these lines are not in your WIN.INI file, you can type them in.

Once these lines are installed in WIN.INI, you'll find that WinWord 6.0 and MacWord 6.0 will also be listed in the Save File As Type list in the Save As dialog box in WinWord 2.0. If you try saving in either format, however, you'll get a message that the converter for this format can only open files.

If you are still using WinWord 2.0 but need to share files with WinWord 6.0 users, you can get the necessary text-conversion file with an installation utility, without charge, by calling Microsoft Product Support (206-462-9673) or Microsoft Sales (800-426-9400). You can also get the file through the MSWORD Forum on CompuServe or from the Microsoft

Download Service (206-936-6735, 2400 to 9600 bps, N, 8, 1). The file you want is named MSWRD6.EXE; it's a self-extracting executable file, complete with the installation utility.

Finally, bear in mind that heavily formatted files may not convert properly. I had no problem, however, moving these comments back and forth between WinWord 2.0 and WinWord 6.0 several times while writing this response.

—M. David Stone

Spreadsheets

APPLYING A LABEL NAME TO A RANGE IN 1-2-3

❓ I've got a problem in Lotus 1-2-3 for Windows. I want to create a spreadsheet with over 200 columns. Each column is to have a different range name, and in each case, the range name is to be the same as the label in the first row of the column. In each case, the names will be applied to rows 2 through 250 of the column.

To enter each range and address manually would not only be quite tedious but would invite transcription errors as well. Can you help with a macro that would handle this for me?

Bruce Morin
Crown Point, Indiana

► **PC MAGAZINE:** The following macro should do the job in any version of Lotus 1-2-3:

```
\t {windowsoff}{panelloff}
{goto}a:a1"
loop {if @cellpointer("type")
="b"}{home}{quit}
{recalc next}
next +"/rnc"&@CELLPOINTER("contents")&
""{BS}{D}.{END}{D}""
{right}
{branch loop}
```

Assign the names \t, loop, and next to the corresponding cells in the second column. That is, if you put \t in A1, you'd put its macro code in B1, and so forth. Enter the contents of the fourth line literally—that is, without a label prefix. This line is a string formula that generates the appropri-

ate range name and range reference at each iteration of the macro's loop. When you enter this formula for the first time, it will return ERR, but don't be deterred.

The macro makes two assumptions: that the columns to be named begin at A:A1 and that there are no blank cells within the area where you want to create range names. Given these conditions, the macro adjusts the range-name references to the rows that are actually populated, whether that includes everything from rows 2 through 250. If you'd rather hard-code the macro so that it always assigns its names to rows 2 through 250, change the string formula to

```
+"/rnc"&@CELLPOINTER("contents")
&"~"&@REFCONVERT(@CELLPOINTER
("col"))&"2.."&@REFCONVERT
(@CELLPOINTER(" col"))&"250"
```

This formula assumes that your version of 1-2-3 includes the function @REFCONVERT.

Note that the Use Labels button in 1-2-3 for Windows' Range Name dialog box can apply a label-based name to only the first cell immediately adjacent to the label—even if you first select the entire column that you want named. That rather silly limitation has been eliminated in Quattro Pro for Windows and Microsoft Excel; in those programs, you wouldn't need a macro. You could simply select the entire block of rows and columns and issue a single menu command. Hopefully, a future version of 1-2-3 will offer this convenience.—Craig Stinson

Databases

SUSPENDING A FOXPRO PROGRAM

✓ **TIP** Here's a tip that will come in handy if you need to suspend your FoxPro program at a point when you can't get to the command window and haven't already bound the SUSPEND command to a hotkey with an ON KEY LABEL command. Just go to the Debug window, enter the TIME() function in the left pane of the Debug window, and then place a breakpoint on it. Then when you click

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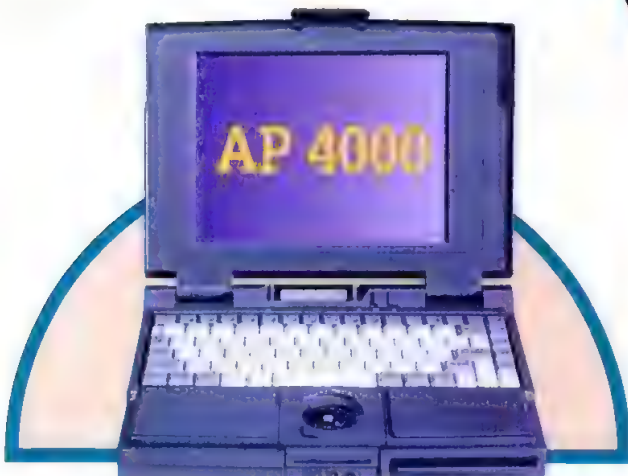


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CIRCLE 197 ON READER SERVICE CARD

back into your application and do anything, the program will suspend as soon as it executes a line of code.

Barry Chertov
Sebastopol, California

► **PC MAGAZINE:** This is a clever way to put your FoxPro program on hold. When you place the TIME() function in the left partition of the Debug window, FoxPro constantly monitors and displays the character string it uses to represent the current time. By clicking on the breakpoint column (between the two partitions) in the Debug window, you establish a program breakpoint that suspends program execution whenever the displayed value changes. Thus FoxPro will suspend execution whenever the value returned by the TIME() function changes—that is, every second.—*Sal Ricciardi*

HELP FOR FOXPRO DEVELOPERS

❓ Now that FoxPro versions are available for DOS, Windows, and the Macintosh, are there any sources that can help in developing cross-platform applications?

Roger Allen
Chicago, Illinois

► **PC MAGAZINE:** The three current FoxPro versions (a Unix version is promised) are substantially similar, so the marketing pitch is that with minimal effort, you can develop an application that runs on all these platforms. This is indeed possible, but the road to that goal is paved with many oops and gotchas. To develop a cross-platform application that is easy to develop, functional, and appealing, you must first make a fairly major effort to learn all of the tips, techniques, and insider knowledge requisite to cross-platform success. This shouldn't shake too many of you: If you've been around Xbase for a while, you know that insider knowledge and undocumented or poorly understood features are a way of life.

I can't yet suggest anything that covers the Macintosh version, but in terms of documenting the quirks and differences between the DOS and Windows versions and of supplying general information on cross-platform strategies, I recommend

Nancy Jacobsen's *Developing Cross-Platform Applications in FoxPro 2.5* (a companion disk includes useful sample programs and utilities). It's one in a series of books for FoxPro developers published by Pinnacle Publishing. Jacobsen's book won't give you a magic recipe that makes all cross-platform programming effortless; there is no such cookie. But if you're serious about creating cross-platform FoxPro applications, this should be one of your references. This volume costs \$39—the price you pay for such highly focused material.

Additional volumes either available now or planned in Pinnacle's The Pros Talk Fox 2.5 Special Report series include *The FoxPro 2.5 Screen Builder*, *FoxPro 2.5 OLE and DDE*, *The FoxPro 2.5 API*, *Creating Mission-Critical Applications in FoxPro 2.5*, and *FoxPro 2.5 Rapid Application Development*. The entire series can be purchased for \$169 through a subscription plan. Volumes available now are shipped immediately, the others are shipped as soon as they're printed. Contact Pinnacle Publishing at 800-788-1900 or 206-251-1900.—*Sal Ricciardi*



INSTANT IMPOSITIONS

❓ I need a Windows utility that will print on a single sheet of paper more than one page created by an application. Specifically, I'm using Ventura Publisher for Windows to produce a 40-page document in a 5.5- by 8.5-inch portrait format. The finished result will be folded to make a booklet. My HP 4Si printer with its duplexer is more than capable of the task, but I have yet to find any software capable of printing pages 1 and 40 as a spread while utilizing the duplexer to print pages 2 and 39 on the other side of the paper in the same pass. Any suggestions?

William Smith
Tucson, Arizona

► **PC MAGAZINE:** You can quickly create booklets from Ventura Publisher or any

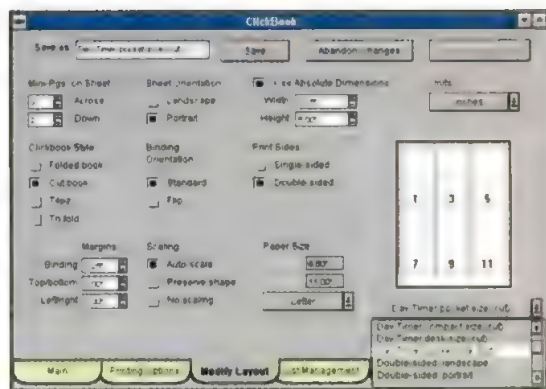


Figure 4: ClickBook's various options include scaling factors, binding methods, and paper orientation. ClickBook always shows you a schematic drawing of the current imposition.

other Windows-based application by installing ClickBook, from BookMaker Corp. (800-766-8531 or 415-617-1101). This \$69.95 utility program, shown in Figure 4, installs itself under Windows as a virtual printer that duplicates all of the capabilities of your actual printer—including features like duplexing. Choosing the ClickBook printer (designated by a CB prefix) invokes a pop-up window in which you can preview the final document or choose from a list of 21 different impositions. (An *imposition* is a special layout in which publication pages are arranged on a sheet of paper. When flat, the pages seem to be out of order, but when properly folded and trimmed, they are in the correct order to form a book.)

ClickBook 1.0 will take advantage of duplexing if you've turned that feature on in the Printer Control Panel. Version 1.1, which should be available by the time you read this article, will allow you even more direct access to the duplexing functions from within the ClickBook program.

ClickBook is chock full of highly useful features. For example, users who don't own a duplex printer will appreciate the screen prompts and the special instruction page that take the trial and error out of two-pass printing. Your letter indicates that in order to fit two publication pages on each side of an 8.5- by 11-inch sheet of paper, you've already reduced the size of your pages to 5.5 by 8.5 inches. But one of ClickBook's smartest features is the ability to scale pages at print time, making the manual reduction of the publication-page size unnecessary.—*Luisa Simone*

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Modem	Yes	Optional (\$79)	Optional (\$49)	Optional (\$49)
Remote Diagnostics Sftw.	Yes	No	No	No
Case	Full Size	Desktop	Baby AT	Desktop
External Cache	128K	128K	128K	No
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PC Computing Service Value Rating (Aug. 1993)	★★★★★	★★★★★	★★★★★	★★★★★
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- VTech designs and manufactures our own components so we control the quality, features and performance.
- With over 11,000 employees and 3 research and engineering labs VTech has the technology and resources to build incredible systems.
- Our prices are among the lowest in the industry because we supply systems to some of the largest manufacturers in the world and that helps us keep production high and prices low.
- 3 year warranty* - PC Computing gave VTech a 5 Star Service Value Rating beating out Dell, Gateway, ZEOS, IBM and Compaq.

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Expo 486SX33M

- Pentium Technology Ready
- 4MB RAM
- 210MB 14ms IDE Hard Drive
- Double Speed CD-ROM
- Stereo Sound Board
- Local Bus Graphics with 1MB
- 3.5" Diskette Drive
- 14" VTech HiRez Monitor
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty*

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\$1349 with 486SX25

Expo 486DX33VM

- **Intel Verified:** for the Pentium™ OverDrive™ Processor
- 4MB RAM with 128KB Cache
- 424MB 13ms IDE Hard Drive
- Double Speed CD-ROM
- 16-Bit Stereo Sound Board
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Dual Cooling Fans
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty*

\$1749

Expo 486DX2/50VM

- **Intel Verified:** for the Pentium™ OverDrive™ Processor
- 8MB RAM with 128KB Cache
- 424MB 13ms IDE Hard Drive
- Double Speed CD-ROM
- 16-Bit Stereo Sound Board
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Dual Cooling Fans
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty*

\$1949

Expo 486DX2/66VM

- **Intel Verified:** for the Pentium™ OverDrive™ Processor
- 8MB RAM with 128KB Cache
- 527MB 12ms IDE Hard Drive
- Double Speed CD-ROM
- 16-Bit Stereo Sound Board
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Dual Cooling Fans
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty*

\$2199



Hot New VESA Systems...

**3 YEAR
WARRANTY**

Prices You Can't Beat

The VTech VESA systems have been specially optimized to deliver the speed and graphics performance that today's Windows applications demand. Each system is equipped with two VESA slots and extra attention has been placed on system compatibility with a wide range of VESA cards. These systems deliver great Windows performance and the extra features you want, at prices you can afford.

The ExpoTech family of VESA systems is available with a wide range of processors, hard drives and memory combinations. All VTech systems are covered by a 3 year warranty* and include the extra features and support VTech is known for.

- 2 VLB Slots
- Novell Certified
- Advanced case design with dual cooling fans
- 30 day money back guarantee

The Expo 486 VESA Multi-Media system

The VTech VESA systems are loaded with extra features. Dual Cooling Fans keep the processor, system board, and option cards cool. This means if you upgrade to the Pentium™ OverDrive™ Processor it will be safe and reliable. In fact, these systems have been Intel Verified: for the Pentium™ OverDrive™ Processor.

VTECH®
expotech™

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\$

expotech series

Expo 486SX33V

- Intel Verified: for the Pentium™ OverDrive™ Processor
- 4MB RAM
- 210MB 14ms IDE Hard Drive
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Dual Cooling Fans
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty*

\$1199

Expo 486DX33V

- Intel Verified: for the Pentium™ OverDrive™ Processor
- 4MB RAM with 128KB Cache
- 424MB 13ms IDE Hard Drive
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Dual Cooling Fans
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty*

\$1499

Expo 486DX2/50V

- Intel Verified: for the Pentium™ OverDrive™ Processor
- 8MB RAM with 128KB Cache
- 424MB 13ms IDE Hard Drive
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Dual Cooling Fans
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty*

\$1649

Expo 486DX2/66V

- Intel Verified: for the Pentium™ OverDrive™ Processor
- 8MB RAM with 128KB Cache
- 527MB 12ms IDE Hard Drive
- VLB Graphics with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Dual Cooling Fans
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty*

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Double Your Power...



"The Awesome VTech Platinum..."

Computer Shopper, February 1994

VTech is the first and only company to bring Symmetrical Multiprocessing to the desktop at prices that blow away even single processor systems. Just look what the experts are saying.

• "The overall performance of the VTech gave it the highest rating of any of the 486 systems, and the jaw dropping price is outstanding."
Computer Shopper, February 1994

• "VTech leads in PC Multiprocessing."
PC Magazine, October 12, 1993

• "This system costs less than many single Pentium™ platforms and its performance, at least under NT, would be 20 to 30 percent faster for any multithreaded application."
Computer Shopper, 1994

Only VTech can deliver your choice of advanced SMP and Pentium systems. Pentium systems are the next frontier of PC performance. If you have a need for speed the VTech Pentium systems will deliver. Utilizing the PCI bus the VTech systems deliver high power at breakthrough pricing.

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Platinum Series

Platinum 486DX2/50

- Intel 486DX2/50 Processor
- Intel Verified: for the Pentium™ OverDrive™ Processor
- 8MB RAM
- 424MB 13ms IDE Hard Drive
- 256KB Copy Back Cache
- SCSI II w/ built-in BIOS support
- 16550 Serial Port Controllers
- Multiprocessor Upgrade Slot
- S3 VLB Accelerator with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty*

\$1949

Platinum 486DX2/66

- Intel 486DX2/66 Processor
- Intel Verified: for the Pentium™ OverDrive™ Processor
- 8MB RAM
- 424MB 13ms IDE Hard Drive
- 256KB Copy Back Cache
- SCSI II w/ built-in BIOS support
- 16550 Serial Port Controllers
- Multiprocessor Upgrade Slot
- S3 VLB Accelerator with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty*

\$2249

Platinum 486DX2/66²

- Dual Intel 486DX2/66 Processors
- Intel Verified: for the Pentium™ OverDrive™ Processor
- 8MB RAM
- 527MB 12ms IDE Hard Drive
- Double Speed CD-ROM
- 256KB Copy Back Cache
- SCSI II w/ built-in BIOS support
- 16550 Serial Port Controllers
- S3 VLB Accelerator with 1MB
- 3.5" Diskette Drive
- 15" VTech HiRez Monitor
- Windows NT
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 - Keyboard & Mouse
- 3 Year Warranty*

\$3249

Platinum P5-60

- Intel 60MHz Pentium™ CPU
- 8MB RAM with 256k Cache
- 424MB 13ms IDE Hard Drive
- PCI Local Bus Graphics with 1MB
- 3.5" Diskette Drive
- Enhanced Parallel Port
- High Speed Serial Port Controllers
- 15" VTech HiRez Monitor
- Double Speed CD-ROM
- MS-DOS 6.2 & Windows 3.1
- Quality Keyboard, Mouse
- 3 Year Warranty*

\$2799

VTech Value Systems...



and Power Portables

The ExpoTech series of integrated systems from VTech have been our most popular systems. Their great combination of performance, features, and low price have made them the clear choice for anyone looking for great value.

Integrated means we've combined as many features and performance enhancements as possible into the main system board. This integration creates a well designed board with exceptional reliability and performance.

BEST BUY

Expo 486SX33

- Pentium™ Technology Ready
- 4MB RAM
- 210MB 14ms IDE Hard Drive
- Local Bus Graphics with 1MB
- 3.5" Diskette Drive
- 14" VTech HiRez Monitor
- Full Size Metal Desktop Case
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 -Keyboard & Mouse
- 3 Year Warranty*

\$1099
\$1049 with 486SX25

Expo 486DX33

- Pentium™ Technology Ready
- 4MB RAM with 128KB Cache
- 424MB 13ms IDE Hard Drive
- Local Bus Graphics with 1MB
- 3.5" Diskette Drive
- 14" VTech HiRez Monitor
- Full Size Metal Desktop Case
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 -Keyboard & Mouse
- 3 Year Warranty*

\$1399

Expo 486DX2/50

- Pentium™ Technology Ready
- 4MB RAM with 128KB Cache
- 424MB 13ms IDE Hard Drive
- Local Bus Graphics with 1MB
- 3.5" Diskette Drive
- 14" VTech HiRez Monitor
- Full Size Metal Desktop Case
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 -Keyboard & Mouse
- 3 Year Warranty*

\$1449

Expo 486DX2/66

- Pentium™ Technology Ready
- 8MB RAM with 128KB Cache
- 424MB 13ms IDE Hard Drive
- Local Bus Graphics with 1MB
- 3.5" Diskette Drive
- 14" VTech HiRez Monitor
- Full Size Metal Desktop Case
- MS-DOS 6.2 & Windows 3.1
- Enhanced 101 -Keyboard & Mouse
- 3 Year Warranty*

\$1699

The ExpoTech Notebooks offer a great combination of features and price. The removable hard drive provides versatility usually found only on systems costing hundreds more.

- Portable - Weighs less than 7lbs.
- Powerful - 4MB RAM and 120MB HD
- 9600/2400 Data/Fax modem
- 1 Year Warranty on Notebooks

ExpoNote 486SLC/33

- Weighs less than 7 lbs.
- 4MB RAM
- 120MB Hard Drive
- Removable Hard Drive
- 640x480 VGA with 64 grey levels
- Simultaneous External VGA port
- 3.5" Diskette Drive
- 9600/2400 Data/Fax Modem
- Dual voltage AC adaptors
- MS-DOS 6.0 & Windows 3.1
- Only 2.1"(H) x 11.4"(W) x 9.25"(D)
- Power management functions
- Full Size Mouse

\$1249
\$899 with 386SX/33

Modem not included in 386SX/33



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CIRCLE 305 ON READER SERVICE CARD



MIDWEST MICRO'S MAKING HEADLINES

A PULITZER PRIZE

For outstanding achievement in customer satisfaction...the prize goes to MidWest Micro. After more than a decade in the business, MidWest Micro is still making headlines across America with top-of-the line products, great value and friendly service. You know you can count on us for the latest technology at the best possible prices.

HOT OFF THE PRESS

At MidWest Micro, we always go out of our way for you. We even give you the option of custom configuring a desktop system in one of five sleek case designs (slimline, desktop, mini-tower, middle-tower and full-tower). We'll install fax modems, more RAM, a larger hard drive and more.



[illegible][illegible]

MidWest Micro tops the news with the Real Three Year Warranty that covers the monitor, hard drive and all internal components – but we don't want to offset all the other services our customers enjoy, like a **30-Day Money Back Guarantee, Immediate Parts Replacement Policy, Lifetime Toll-Free Technical Support and an On-Line Bulletin Board Service.** No matter how the other companies word it, they just don't deliver service and support like this.

1-800-682-7256



News Newer Traveled So Fast!

"Did you say clock-tripling speeds?"

"I heard the Three-Year Warranty is for real!"

"Martha told me that buying an Elite System was the smartest thing she's ever done."

"Well, Albert and I just ordered an Elite for our grandson."

What's All The Gossip About?

Did you hear about Elite PCI and Pentium® Systems from MidWest Micro? It's certainly no rumor that Intel's® Pentium processor operates twice as fast as a DX2-66 processor. Plus, superscalar architecture lets it execute two instructions at the same time, dramatically speeding up operation. For such high performance, the price of Elite Systems is very trim.

Pssst... Pass It On

Superior compatibility, automatic configuration and high-speed data handling are making PCI (Peripheral Component Interconnect) Local Bus the talk of the town. Since these systems are self-configuring, adding network cards, video cards and other peripherals has never been easier. (Just ask Martha!)





Another highlight of PCI Technology is great video performance. It gives you up to 16.7 million colors (that won't wash out after you shampoo) and 1280 x 1024 resolution. And with refresh rates up to 90 Hz, screens redraw faster than you can say split ends!

What Else Is New?

What's new? Elite's new line of Pentium Systems travel at an amazing 90 MHz processing speed, one of the fastest speeds available. Known as P5-90s, these Elites also run cooler and draw significantly less power. If you want to make some permanent waves, order an Elite P5-90 Pentium System from MidWest Micro.

Wait, There's More...

The curling iron isn't all that's hot – so are Elite DX4 VESA Systems! We're talking processing speeds up to 75 and 100 MHz! News hasn't traveled this fast since the grapevine was invented! Plus, with a powerful VESA Local Bus, you get increased throughput and high-speed video.

MidWest Micro's Intel-based Systems give you more than high speed and excellent performance. They also come with large hard drives and MS-DOS 6.2® and WFW™ 3.11 installed. Some configurations even include a double speed multimedia CD-ROM drive and an internal send and receive fax modem! Call the company that everybody's talking about – call MidWest Micro today.

Pentium technology is a lot more than just small talk. It can execute two instructions at once, produce processing speeds up to 90 MHz and make everyday applications run even better. Pentium processors also provide the power needed for new multimedia applications and desktop video conferencing.

And if clock-tripling VESA performance dominates your conversations, you need an Elite DX4 VESA System. With a powerful VESA Local Bus, fast processing speed and double-speed CD-ROM drive, this System never makes you wait! If you'd like to talk more about Elite DX4 and Pentium Systems, call one of the friendly sales representatives at MidWest Micro – they love to talk, too!

MidWest Micro

1-800-682-7256

AD#G601



"The fact that the test in the
Microsoft Word 6.0 database certainly lives up to
the name. The 386 is a clean display is well
and especially the enhanced, high performance chip,
internal hard disk and battery assembly. When you add
to that the 386's long battery life and roll free support, at a
very reasonable price, the Elite is the class of this field."

Computer Shopper, May 1994

THE ELITE SOUNDBOOK STEALS THE SPOTLIGHT

This Notebook's Got Something To Say

There's simply no better way to get the word out than with the Elite SoundBook from MidWest Micro. Featuring built-in audio capabilities and the processor, hard drive and screen of choice, the Elite SoundBook is always attracting attention (even when it's not supposed to)!

It Can't Keep Quiet!

It's hard for the SoundBook to keep quiet since it comes with a built-in microphone and speaker, external jacks and bundled audio software. The software lets you easily record, compress, store and playback voices, sounds or music. Plus, the Elite features a PCMCIA Type III slot so you can add modems, flash memory, network adapters, and more.

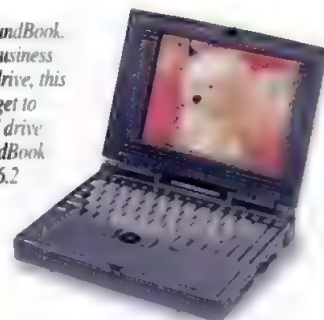
Attracting Attention From Every Angle

The SoundBook also attracts attention with its visual performance. Available in monochrome, dual-scan color and active-matrix color, these screens make presentations look great.

A Keynote Speaker

Even when it's part of the audience, the Elite SoundBook steals the spotlight. Business presentations have never looked or sounded so good! And it comes in a variety of configurations, so you can pick the one that best suits your needs. You can even select a processor with a clock-tripling 100 MHz processing speed! With its long battery life, up to 520 Mb hard drive and local bus video with 1 Mb video DRAM, this lightweight notebook really makes a statement. Invite the Elite SoundBook to your next press conference. It won't just be the topic of discussion—it'll be the main speaker!

The media can't stay away from the Elite SoundBook. With 4 Mb of RAM (expandable to 20 Mb), business audio features and a user replaceable hard drive, this notebook is hot news! And the fact that you get to choose your own processor, screen and hard drive has really got reporters interested. The SoundBook even comes with Lotus Organizer, MS-DOS 6.2 and WFW 3.11 installed. Whether you'd like the color (6.7 lbs.) or monochrome (6.2 lbs.) version, the Elite SoundBook steals the show.



News On a Lighter Note

Ready for more good news? The Elite 486SX-33 SubNote weighs only 3.9 lbs. and comes with a dual-scan color or monochrome screen. With its high-speed RAM and fast processor, this SubNote really beats the press! If you like the lighter side of the news, you're going to love the Elite 486SX-33 SubNote.

MidWest Micro

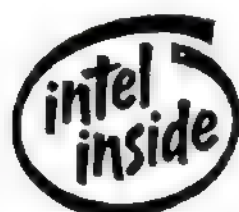
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AD#G602

PENTIUM PCI SYSTEMS

P5-60 \$2299

- #007830
- Intel® 60 MHz Pentium™ Processor
- 8 Mb RAM, 256 Kb Cache
- 340 Mb IDE Hard Drive
- PCI Fast IDE Interface
- PCI Local Bus Graphics
- 3.5" Disk Drive
- 15" SVGA .28 N/I Multi-Scan Color Monitor with Hitachi CRT
- 8-Bay Middle-Tower Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- 101-Key Enhanced Keyboard
- High-Resolution Mouse
- MS-DOS™ 6.2 and WFW™ 3.11



P5-66 \$2699

- #007831
- Intel 66 MHz Pentium Processor
- 8 Mb RAM, 256 Kb Cache
- 528 Mb IDE Hard Drive
- PCI Fast IDE Interface
- PCI Local Bus Graphics with 2 Mb
- Double Speed CD-ROM Drive
- Internal 14.4 S/R Fax Modem
- 3.5" Disk Drive
- 15" SVGA .28 N/I Multi-Scan Color Monitor with Hitachi CRT
- 8-Bay Middle-Tower Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- 101-Key Enhanced Keyboard
- High-Resolution Mouse
- MS-DOS 6.2 and WFW 3.11

P5-66 \$2999

- #007832
- With 1 Gb SCSI HDD & Without 14.4 Internal S/R Fax Modem

P5-66 \$3199

- #007833
- Intel 66 MHz Pentium Processor
- 16 Mb RAM, 256 Kb Cache
- 528 Mb IDE Hard Drive
- PCI Fast IDE Interface
- Intel PCI Local Bus Graphics with 2 Mb
- Double Speed CD-ROM Drive
- Microsoft 3 Disk CD-ROM Software Library – Encarta, Works & Money
- Pro Audio 16 Sound Card
- Digital Quality, Compact Speakers
- Internal 14.4 S/R Fax Modem
- 3.5" Disk Drive
- 15" SVGA .28 N/I Multi-Scan Color Monitor with Hitachi CRT
- 8-Bay Middle-Tower Case
- 3 ISA, 2 PCI & 1 PCI/ISA Slots
- 101-Key Enhanced Keyboard
- High-Resolution Mouse
- MS-DOS 6.2 and WFW 3.11

P5-90 \$3499

- #007834
- Intel 90 MHz Pentium Processor
- 16 Mb RAM, 256 Kb Cache
- 528 Mb IDE Hard Drive
- PCI Fast IDE Interface
- Intel PCI Local Bus Graphics with 2 Mb
- Double Speed CD-ROM Drive
- Internal 14.4 S/R Fax Modem
- 3.5" Disk Drive
- 17" SVGA .26 N/I Color Monitor with Hitachi CRT
- 10-Bay Full-Tower Case
- 3 ISA, 2 PCI & 1 PCI/ISA Slots
- 101-Key Enhanced Keyboard
- High-Resolution Mouse
- MS-DOS 6.2 and WFW 3.11

P5-90 \$3999

- #007835
- With 1 Gb SCSI HDD

VESA AND PCI SYSTEMS

486SX-33 \$1199

- #006674
- Intel 486SX-33 Processor
- 4 Mb RAM, 128 Kb Cache
- 340 Mb IDE Hard Drive
- 32-Bit VESA Local Bus Graphics with 1 Mb
- 32-Bit VESA Local Bus IDE
- 3.5" and 5.25" Disk Drives
- 14" SVGA .28 N/I Color Monitor with Hitachi CRT
- 8-Bay Mini-Tower Case
- 5 ISA & 3 VESA/ISA Slots
- 101-Key Enhanced Keyboard
- High-Resolution Mouse
- MS-DOS 6.2 and WFW 3.11

486DX-33 \$1379

#006675

486DX2-50 \$1399

#006676

486DX2-66 \$1799

- #006677
- Intel 486DX2-66 Processor
- 8 Mb RAM, 128 Kb Cache
- 340 Mb IDE Hard Drive
- 32-Bit VESA Local Bus Graphics with 1 Mb
- 32-Bit VESA Local Bus IDE
- Double Speed CD-ROM Drive
- 3.5" Disk Drive
- 15" SVGA .28 N/I Multi-Scan Color Monitor with Hitachi CRT
- 8-Bay Mini-Tower Case
- 5 ISA & 3 VESA/ISA Slots
- 101-Key Enhanced Keyboard
- High-Resolution Mouse
- MS-DOS 6.2 and WFW 3.11

486DX-33 \$1679

#007808

486DX2-50 \$1699

#007809

DX4-75 \$2399

- #007826
- Intel DX4-75 Processor
- 16 Mb RAM, 128 Kb Cache
- 428 Mb IDE Hard Drive
- 32-Bit VESA Local Bus Graphics with 2 Mb
- 32-Bit VESA Local Bus IDE
- Double Speed CD-ROM Drive
- 3.5" Disk Drive
- 15" SVGA .28 N/I Multi-Scan Color Monitor with Hitachi CRT
- 8-Bay Mini-Tower Case
- 5 ISA & 3 VESA/ISA Slots
- 101-Key Enhanced Keyboard
- High-Resolution Mouse
- MS-DOS 6.2 and WFW 3.11

486DX2-66 \$2299

#007827

DX4-100 \$2499

#007828

DX4-100 PCI \$2999

- #007829
- Intel DX4-100 Processor
- 16 Mb RAM, 128 Kb Cache
- 528 Mb IDE Hard Drive
- 32-Bit VESA Local Bus Graphics with 2 Mb
- Double Speed CD-ROM Drive
- 3.5" Disk Drive
- 17" SVGA .26 N/I Color Monitor with Hitachi CRT
- 8-Bay Middle-Tower Case
- 3 ISA, 2 PCI & 1 PCI/ISA Slots
- 101-Key Enhanced Keyboard
- High-Resolution Mouse
- MS-DOS 6.2 and WFW 3.11

SLIMLINE VALUE SYSTEMS

HOME PC 486DX2-50 \$1799

- #007824
- Intel® 486DX2-50 Processor
- 4 Mb RAM, 128 Kb Cache
- 250 Mb IDE Hard Drive
- 32-Bit Local Bus Graphics with 1 Mb
- 32-Bit Local Bus IDE
- Double Speed CD-ROM Drive
- Microsoft 3 Disk CD-ROM Software Library – Encarta™, Works™ & Money™
- Pro Audio 16 Sound Card
- Digital Quality, Compact Speakers
- 9624 Internal S/R Fax Modem
- 3.5" Disk Drive
- 15" SVGA .28 N/I Multi-Scan Color Monitor with Hitachi CRT
- Slimline Case
- 4 ISA & 1 VESA/ISA Slots
- 101-Key Enhanced Keyboard
- High-Resolution Mouse
- MS-DOS 6.2 and WFW 3.11

486DX2-66 \$1899

#007825

SERVICES

Every MidWest Micro Elite is backed by:

- Three-Year "Real Warranty" on desktops
- One-Year Warranty on portables
- 30-Day Money Back Guarantee
- Immediate Parts Replacement Policy
- Lifetime Toll-Free Technical Support
- On-Line Bulletin Board Service

MONITOR UPGRADE
Ask your sales representative how you can upgrade your monitor to a 15" or 17" Elite monitor.

14" to 15" \$89
14" to 17" \$419
15" to 17" \$319

ELITE NOTEBOOKS

ELITE SoundBook

- Intel® 486, DX2 or DX4 Processor
- 4 Mb RAM (expands to 20 Mb)
- 9.5" Mono, 10.3" Dual-Scan or 9.5" Active Matrix VGA Display
- Local Bus Video with 1 Mb Video DRAM
- Business Audio Features Including:
Built-in Microphone & Speaker
External Jacks for Line In & Line Out
- 3.5" Built-in Disk Drive
- User Replaceable Hard Drive
- Two Type II/One Type III PCMCIA Slot
- Built-in Trackball
- NiMH Battery & AC Adapter
- Advanced Power Management with SMI
- One Parallel & One Serial Port
- External VGA & Keyboard Port
- MS-DOS® 6.2 & WFW™ 3.11
- Lotus Organizer™
- Weight: Mono - 6.2 lbs. Color - 6.7 lbs.
- Carrying Case

Dual Scan Color SoundBook

486SX-33 with 260 Mb HDD
#007328 **\$1999**

486DX-33 with 260 Mb HDD
#007329 **\$2199**

DX2-50 with 340 Mb HDD
#007330 **\$2299**

DX2-66 with 520 Mb HDD
#007331 **\$2499**

DX4-75 with 340 Mb HDD &
8 Mb of RAM
#007332 **\$2799**

DX4-100 with 520 Mb HDD &
8 Mb of RAM
#007333 **\$2999**

Monochrome SoundBook

486SX-33 with 260 Mb HDD
#007334 **\$1499**

486DX-33 with 260 Mb HDD
#007335 **\$1699**

DX2-50 with 340 Mb HDD
#007336 **\$1799**

Options

4 Mb RAM Card	#005976	\$219
8 Mb RAM Card	#005977	\$469
16 Mb RAM Card	#005978	CALL
Car Adapter	#005979	\$ 59
PCMCIA 9624 Fax Modem	#001722	\$149
PCMCIA 14.4 Fax Modem	#001812	\$229
PCMCIA Ethernet Adapter	#001832	\$159

Active Matrix SoundBook

DX2-66 with 340 Mb HDD &
8 Mb of RAM
#007337 **\$3499**

DX4-75 with 520 Mb HDD &
8 Mb of RAM
#007338 **\$3799**

DX4-100 with 520 Mb HDD,
8 Mb of RAM & PCMCIA 9624
S/R Fax Modem
#007339 **\$3999**



* Ask your MidWest Micro sales representative about additional hard drive, screen and processor options.

Elite 486SX SubNote

- Intel 486SX SL-Enhanced Processor
- 4 Mb RAM (expands to 12 Mb)
- 9.5" Mono or Dual-Scan VGA Display
- Turbo Bus Accelerated Video
- 3.5" External Disk Drive
- User Replaceable Hard Drive
- One Type II PCMCIA Slot
- Built-in Trackball

- NiMH Battery & AC Adapter
- Advanced Power Management with SMM
- One Parallel & One Serial Port
- External VGA & Keyboard Port
- MS-DOS 6.2
- Weight: 3.9 lbs.
- Carrying Case

Monochrome SubNote

486SX-25 with 260 Mb HDD
#007342 **\$1299**

486SX-25 with 340 Mb HDD &
PCMCIA 9624 S/R Fax Modem
#007307 **\$1499**

Dual Scan Color SubNote

486SX-33 with 260 Mb HDD &
WFW 3.11
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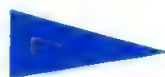
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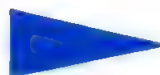
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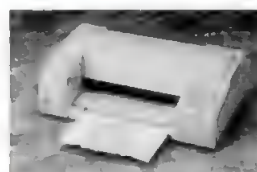
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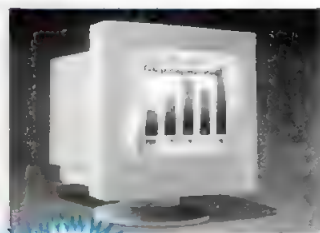
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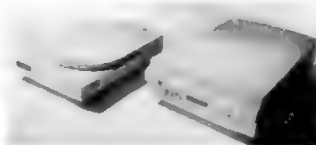
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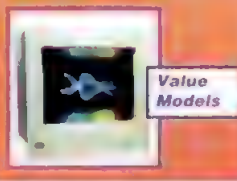
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425SX/Si	none	486SX/25	4MB	64MB	3 (ISA)	2 (1)		\$1389.00
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425SX/Si	340MB	486SX/25	4MB	64MB	3 (ISA)	2 (1)		\$1719.00
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425SX/Si	212MB	486DX2/50	4MB	64MB	3 (ISA)	2 (1)		\$1699.00
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425SX/Si	212MB	486DX2/66	4MB	64MB	3 (ISA)	2 (1)		\$2000.00
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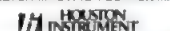
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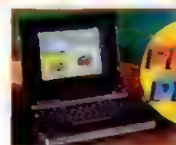
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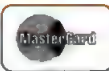
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486SX/33	240MB	\$1259
486DX/33	240MB	\$1469
486DX/33	340MB	\$1619

Lease for \$50/mo.

*Monitors sold separately

Contura 4/25

Screen	Hard Drive	Price
Mono	203MB	\$2199
Dual Scan	203MB	\$2319
Active Matrix	203MB	\$3449

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\$1989*



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Concerto

- ▲ 9.5" mono display
- ▲ 2 PCMCIA Type II slots
- ▲ Integrated, detachable keyboard

Processor	Hard Drive	Price
486SL/25	120MB	\$1989*
486SL/25	250MB	\$2179
486SL/33	250MB	\$2369

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Hard Drive	Modem	Price
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120MB	14.4/14.4	\$1629
170MB	24/96	\$1719
170MB	14.4/96	\$1629

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\$1519*

Z-STAR 433VL

Screen	Hard Drive	Price
Mono	170MB	\$1659
Dual Scan	200MB	\$2349

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- ▲ Intel DX4, 100MHz Processor
- ▲ 16KB internal cache
- ▲ 8MB RAM exp. to 64MB
- ▲ 270/540MB hard drive

Hard Drive	Model	Price
270MB	4 1001 273W	\$2339*
540MB	4 1001 543W	\$2719

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\$2339*



Processor	Hard drive	Price
486SLC/33	120MB	\$779*
486SX/25	170MB	\$919
486SX/33	170MB	\$1009
486DX/33	260MB	\$1249
486DX 33MT	260MB	\$1309
486DX2/66	345MB	\$1699
486DX2/66MT	345MB	\$1839

*VGA color monitors begin at \$209.99

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RAM	Desktop Systems	Price
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16MB	20M-Wm	\$2479

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ISA	60M-Wm	\$2699
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- ▲ MS DOS, Windows 3.1

Screen	Hard Drive	Price
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9.5"	455MB	\$4999

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\$1679*



TM4000E

TravelMate 4000E Monochrome

Processor	Price
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486DX 2.50	\$2429

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Processor	Screen	Price
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486DX2 50	Dual Scan	\$2749
486DX2/50	Active Matrix	\$3349

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- ▲ 512KB integrated cache
- ▲ 16MB RAM
- ▲ SCSI controller standard
- ▲ Local bus graphics
- ▲ Hard drive optional

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Model	Hard Drive	Price
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- ▲ 360dpi resolution

Processor	Hard drive	Price
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486SX/25	200MB	\$3169

\$2839*



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Model	Price
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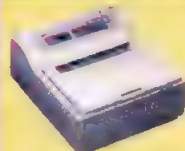
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Model	Price
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- ▲ 3-year warranty

Screen	RAM
Mono	4MB
Dual Scan	4MB

COMPAQ Concerto

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Processor	RAM	Hard Drive
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Concerto
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- ▲ Local bus graphics
- ▲ COMPAQ mouse
- ▲ MS DOS 6.0, Windows 3.1

Processor	RAM	Hard Drive
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486SX/33	4MB	240MB
486DX/33	4MB	120MB
486DX/33	4MB	240MB
486DX2/50	4MB	240MB
486DX2/66	4MB	340MB

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- ▲ Local bus graphics
- ▲ 5 expansion slots, 5 drive bays
- ▲ COMPAQ mouse
- ▲ MS DOS 6.0, Windows 3.1, TabWorks

Processor	RAM	Hard Drive
486SX/33	4MB	270MB
486SX/33	4MB	340MB
486DX2/50	4MB	340MB
486DX2/66	8MB	525MB

ProLinea Net1

- ▲ 486SX/25 or 486SX/33 processor
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- ▲ MS-DOS 6.0, Windows 3.1, TabWorks

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- ▲ 3.5" floppy drive
- ▲ 4 32-bit EISA expansion slots
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- ▲ COMPAQ mouse
- ▲ MS DOS 6.0, Windows 3.1

Processor	RAM	Hard Drive
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486DX/33	8MB	340MB
486DX2/66	8MB	510MB

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- ▲ Ballpoint mouse with Quickport
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Model	Processor	Screen	Hard Drive	Price
T1910	486SX/33	Monochrome	120MB	\$1499
T1910	486SX/33	Dual scan color	120MB	\$2099
T1910	486SX/33	Dual scan color	200MB	\$2329
T1950	486DX2/40	Monochrome	200MB	\$2099
T1950	486DX2/40	Dual scan color	200MB	\$2719
T1950	486DX2/40	Active color	200MB	\$3029
T1950	486DX2/40	Active color	320MB	\$3399

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- ▲ 8MB RAM, expandable to 24MB
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- ▲ 2 PCMCIA slots (Type II, Type III)
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- ▲ MS-DOS, UltraFont, Indeo video compression software, Windows 3.1 (T4700)/Windows for Workgroups 3.11 (T4800)

Model	Processor	Screen	Hard Drive	Price
T4700	486DX2/50	Dual scan color	200MB	\$3999
T4700	486DX2/50	Dual scan color	320MB	\$4329
T4700	486DX2/50	Active color	200MB	\$4599
T4700	486DX2/50	Active color	320MB	\$4949
T4800	486DX4/75	Active color	500MB	\$5619

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T4700



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- ▲ ColorSmart technology
- ▲ Resolution Enhancement Technology for smooth, crisp text and graphics
- ▲ Select DeskJet for PCs and DeskWriter for Macintosh
- ▲ 3-Year warranty

DeskJet 560C	\$579.99
DeskWriter 560C	\$579.99

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- ▲ 1024x768, 28mm ni
- ▲ 72MHz VESA refresh rate
- ▲ MPR II, EnergyStar compliant
- ▲ Great for Entry-level business/Windows applications



\$469.99

5FGp

- ▲ 17" SVGA
- ▲ 1280x1024, 28mm ni
- ▲ Opticlear surface
- ▲ Intelligent Power Management System
- ▲ Great for entry-level CAD, color desktop publishing



\$1109.99

6FGp

- ▲ 21" SVGA
- ▲ 1280x1024, 28mm ni
- ▲ Opticlear surface
- ▲ Intelligent Power Management System (IPM)
- ▲ Great for professional CAD/CAM/CAE, graphic design, color desktop publishing

\$2019.99

NEC

UltraLite Versa E

- ▲ 486 processor
- ▲ 4MB RAM, expandable to 20MB
- ▲ 2 Type II PCMCIA slots
- ▲ MS-DOS 6.2, Windows 3.1, built-in trackball

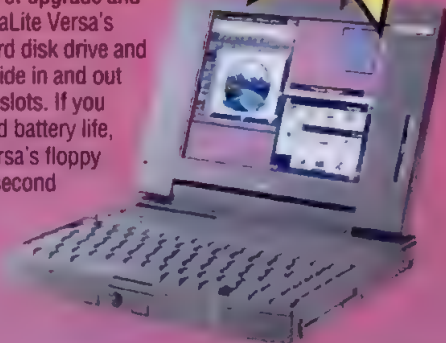
Processor	Screen	Hard drive	Price
DX2/40	Active color	120MB	\$3819
DX2/40	Active color	250MB	\$4229
DX2/50	Monochrome	209MB	\$3259*
DX2/50	Active color	209MB	\$4499
DX2/50	Active color	340MB	\$4919
DX4/75	Active color	340MB	\$5229

Lease for \$120/mo.

\$3259*

UltraLite Versa E

The Versa E notebook series is upgradable to grow with your needs. For ease of upgrade and service, the UltraLite Versa's floppy drive, hard disk drive and memory card slide in and out of their storage slots. If you require extended battery life, slide out the Versa's floppy drive, pop in a second battery, and double your time on the road.



Ready Multimedia Desktops

Get Ready for an impressive multimedia system from NEC. The Ready 425CD2 and Ready 433CD3 feature built-in ready-to-run CD-ROM readers, a complete sound system, and a comprehensive software offering to introduce you to multimedia computing. Also sporting local bus graphics and 24-bit true color, the multimedia Ready will speed through your applications and display them in bright, clear colors.



Ready Multimedia Desktops

- ▲ 4MB RAM expandable to 36MB
- ▲ 9600/4800 fax, 2400 data modem
- ▲ Fast double or triple speed CD-ROM
- ▲ MediaVision sound card, speakers
- ▲ MS-DOS, Windows 3.1, America-On-Line, CompuServe
- ▲ CD-ROM titles include: PFS: Window Works, Compton's Encyclopedia, Dinosaur Adventure and Space Adventure

Processor	Hard drive	Price
486SX/25	170MB	\$1429
486SX/33	250MB	\$1799

NEC SVGA monitor \$319.99

Lease for \$52/mo.

\$1429

PowerMate Desktops

- ▲ 4MB RAM expandable to 36MB
- ▲ 8KB cache expandable to 256KB
- ▲ Local bus True Color video
- ▲ Graphics accelerator
- ▲ 3 expansion slots, 3 drive bays
- ▲ MS DOS, Windows 3.1, NEC mouse

Processor	Hard drive	Price
486SX/33	170MB	\$1129
486DX2/50	210MB	\$1399
486DX2/66	210MB	\$1749

NEC SVGA monitor \$319.99

Lease for \$55/mo.

\$1129

PowerMate Desktops

Meeting your needs for aggressive pricing and outstanding quality, the PowerMate 486 series features local bus video and a graphics accelerator to deliver falcon-like speed. By combining 486 processing power with advanced graphics support, the PowerMate takes you to new heights in performance.



NEC MultiSpin 3X CD-ROM Drives

New from NEC—the fastest CD-ROM Drives available

- ▲ Triple speed 450Kb/sec transfer rate, 195ms access time & 256K buffer
- ▲ MPC Level 2 compliant, Multisession Photo CD & XA-compliant
- ▲ Sleek new design features front panel LCD controls for display of data, audio & diagnostics data
- ▲ Full audio control buttons (play, repeat, track advance, pause, stop) on front panel for your music CDs. And play audio CDs without a PC.

MultiSpin 3Xp Portable Drive	\$429.99
MultiSpin 3Xi Internal Drive	\$479.99
MultiSpin 3Xe External Drive	\$569.99

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- ▲ 4MB RAM exp. to 64MB
- ▲ VESA Local Bus graphics
- ▲ 512KB Video RAM exp. to 1MB
- ▲ 2 Serial, parallel, mouse, and keyboard ports
- ▲ IBM DOS 6.1/MS Windows 3.1, mouse, enhanced 101 keyboard

Processor	Hard Drive	Price*
486SX/25	120MB	\$889**
486SX/25	120MB	\$929
486DX/33	212MB	\$1399
486DX2/66	212MB	\$1789

*includes IBM basic keyboard

ValuePoint® Desktops

Maximum expandability in a desktop

- ▲ 4MB RAM exp. to 64MB
- ▲ Pentium upgradable
- ▲ VESA Local Bus graphics (w/open VESA slot)
- ▲ 1MB Video RAM exp. to 2MB
- ▲ 5 expansion slots, 5 drive bays
- ▲ IBM DOS 6.1, MS Windows 3.1, mouse

Processor	Hard Drive	Price*
486SX/33	170MB	\$1359
486DX/33	212MB	\$1559
486DX/33	340MB	\$1719
486DX2/66	340MB	\$2159

Minitower models also available

ThinkPad® 350 Notebooks

Performance in just 5.2lbs

- ▲ 486SL25 processor
- ▲ 4MB RAM exp. to 20MB
- ▲ Local Bus Graphics
- ▲ 9.2" VGA color or 9.5" VGAmochrome screen
- ▲ 1 PCMCIA Type II slot
- ▲ TrackPoint II integrated pointing device
- ▲ IBM DOS, PRODIGY

Screen	Hard Drive	Price
Monochrome	250MB	\$2219
Passive Color	125MB	\$2199
Passive Color	250MB	\$2609



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The ultimate power trip

- ▲ 16MB RAM exp. to 128MB
- ▲ 256KB cache standard
- ▲ 4 expansion slots (2 PCI, 1 PCI/AT, 1 AT)
- ▲ 5 drive bays

Processor	Hard Drive	Price*
Pentium 60MHz	424MB	\$4039
Pentium 60MHz	525MB	\$4099

*monitor priced separately

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Lighten your load, and increase your power

- ▲ IBM 486SLC2/50 processor
- ▲ 4MB RAM exp. to 12MB
- ▲ 170MB hard drive
- ▲ 7.4" VGA monochrome display
- ▲ 1 Type II PCMCIA slot
- ▲ TrackPoint II integrated pointing device
- ▲ 3.5" external floppy drive
- ▲ NiMH battery, AC adapter
- ▲ Weighs only 3.8 lbs. (w.battery)
- ▲ IBM DOS 6.1, Prodigy



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- ▲ 4/8MB RAM exp. to 64MB
- ▲ VESA local bus graphics
- ▲ 1MB video RAM
- ▲ MS-DOS 6.2, Windows 3.1
- ▲ Energy Star Compliant

Model	RAM	Hard Drive	Price
4/33s Model 173W	4MB	170MB	\$1139
4/33s Model 273W	8MB	270MB	\$1369
4/50s Model 173W	4MB	170MB	\$1359
4/50s Model 273W	8MB	270MB	\$1589
4/66d Model 273W	8MB	270MB	\$1889
4/66d Model 543W	8MB	540MB	\$2269
4/100t Model 273W	8MB	270MB	\$2339
4/100t Model 543W	8MB	540MB	\$2719

Lease for \$50/mo.

Bravo MT

- ▲ 2/4/8MB RAM exp. to 64MB
- ▲ Optional 170/340MB hard drive
- ▲ 32-bit accelerated local bus graphics

Model	Hard Drive	Price
4/33 Model 3	Optional	\$1239
4/33 Model 173W	170MB	\$1499
4/33 Model 343W	340MB	\$1979
4/66d Model 3	Optional	\$1659
4/66d Model 173W	170MB	\$1929
4/66d Model 343W	340MB	\$2399

Lease for \$50/mo.

Bravo NB

- ▲ 486SX/25 or 486SX/33 processor
- ▲ Accelerated local bus graphics
- ▲ PCMCIA Type III slot

Model	Screen	Hard Drive	Price
4/33s 203W	Mono	200MB	\$1629
4/33s 203W	Mono	200MB	\$2249
4/25s 123W	Mono	120MB	\$1449
4/25s 173W	Mono	170MB	\$1539

Lease for \$60/mo.

PowerExec

- ▲ 4/33SL
- ▲ 4/8MB RAM exp. to 32MB
- ▲ 9.5" display
- ▲ 1 Type III PCMCIA

Model	Screen	Hard Drive	Price
4/33SL Model 203W	Mono	200MB	\$2259
4/33SL Model 203W	Active	200MB	\$3899
4/33SL Model 343W	Active	340MB	\$4299

Lease for \$83/mo.

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Choose from a variety of AST DPMS compliant monitors to complete your desktop system.

Monitor	Description	Price
ASTVision 4L	14" low radiation, NI	\$399.99
ASTVision 5L	15" low radiation, NI	\$529.99
ASTVision 7L	17" low radiation, NI	\$949.99



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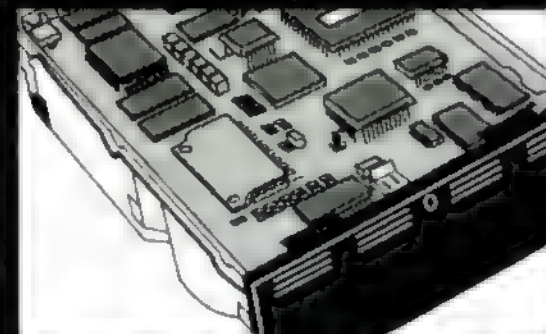
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540MB Drive, GSI-21 accelerator card	\$449
540MB Drive, GSI-21, 250MB Tape, 2 tapes	\$609
540MB Drive, Local Bus Cache card	\$529
1Gig Drive, GSI-21 accelerator card	\$799
1Gig Drive, GSI-21, 250MB Tape, 4 tapes	\$939

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1Gig Drive, 32Bit EISA card	\$1399
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SCSI DRIVE BUNDLES

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1Gig Drive, Local Bus Cache Card	\$1079
1Gig Drive, 2Gig DAT, 1 tape	\$1599
1Gig Drive, 32Bit Local Bus	\$929
1.7Gig Drive, 16Bit ISA	\$1099
1.7Gig Drive, Local Bus Cache Card	\$1309
1.7Gig Drive, 2Gig DAT, 1 tape	\$1839
1.7Gig Drive, 32Bit Local Bus	\$1169

2Gig Drive, 32Bit EISA card	\$2099
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SyQuest

IDE Drive Bare 105 / 270 with GSI-18 & 1 disk \$239 / \$409
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External for Macintosh & 1 Disk \$399 / \$619

3 1/2" Removable Media Drives. The #1 storage solution for the 1990's. Hard drive speed, low cost per MB. Mounts in 3 1/2" or 5 1/4" bay. Great for unlimited upgradability, data archival, etc. 105MB 14.5ms, 64K buffer. 270MB 13.5ms, 128K buffer.

SCSI Drive Bare 105 / 270	\$279 / \$429
with Adaptec 1522 & 1 disk	\$399 / \$629
with Adaptec 1542 & 1 Disk	\$529 / \$759
External for Macintosh & 1 Disk	\$399 / \$629

GSI drive accelerators increase the data transfer rate of your IDE drive 30 to 80%. Works by enabling the drives Read Multiple & Write Multiple commands to greatly increase performance. We highly recommend these products for WD, Conner, Quantum, Seagate, Micropolis, Maxtor, & Fujitsu. Alone w/Drive
GSI-21 Board supports 2 IDE, 4 floppy drives. Doubles QIC-80 tape drive speed \$65 \$55
GSI-18 Board supports 2 IDE drives. Works in conjunction with MFM, RLL, etc. \$55 \$45
GSI-32 Board same as -21 adds 2 16550 serial ports & 1 bi-directional parallel port \$139 \$119
GSI MaxIDEA Software solution works on existing IDE configuration (requires less than 1K of memory). Includes performance benchmark test. \$34 \$25

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CONNER

IDE			
210MB	14ms	CFS210A	\$202
340MB	13ms	CFA340A	\$272
420MB	14ms	CFS420A	\$290
541MB	12ms	CFA540A	\$399
SCSI			
1060MB	9ms	CFP1060S	\$789

Maxtor

IDE			
245MB	15ms	7245A	\$249
345MB	14ms	7345A	\$278
540MB	12ms	7546A	\$392
SCSI			
340MB	14ms	7345S	\$349

MICROPOLIS

IDE			
1050MB	10ms	MC4110A	\$819
1740MB	10ms	MC2217A	\$1099
SCSI			
1052MB	8.5ms	MC4110	\$819
1740MB	10ms	MC2217	\$1122
3020MB	11ms	MC1936	\$2099
SCSI-AV Audio / Visual tuned drives			
1000MB	10ms	MC2210AV	\$925
1700MB	10ms	MC2217AV	\$1229

Seagate

IDE			
213MB	16ms	ST3243A	\$204
260MB	16ms	ST3290A	\$222
341MB	13ms	ST3391A	\$280
452MB	12ms	ST3550A	\$323
SCSI (WIDE SCSI also available)			
1690MB	8ms	ST11950N	\$1469
2145MB	8ms	ST12550N	\$1639
2148MB	9ms	ST12400N	\$1399

WESTERN DIGITAL

IDE			
256MB	12ms	AC2250	\$239
341MB	12ms	AC2340	\$269
425MB	12ms	AC2420	\$295
540MB	11ms	AC2540	\$395
730MB	10ms	AC2700	\$629
1083MB	10ms	AC31000	\$799

HARD DRIVES

Quantum

IDE			
170MB	14ms	LPS170A	\$199
270MB	12ms	LPS270A	\$229
342MB	12ms	LPS340A	\$269
541MB	12ms	LPS540A	\$425
SCSI			
170MB	14ms	LPS170S	\$199
270MB	12ms	LPS270S	\$229
342MB	12ms	LPS340S	\$289
541MB	12ms	LPS540S	\$449
1080MB	10ms	IMP1080	\$769
1800MB	10ms	PD1800S	\$969
2160MB	9.5ms	IMP2160S	Call

digital

2103MB	9ms	DSP3210	\$1559
4000MB	11ms	DSP5400	\$2679

IBM PS/1 PS/2 DRIVES

Complete solutions for your IBM. Larger sizes in stock!			
	170MB	270MB	340MB
PS/1 386 & 486	\$239	\$299	\$349
PS/2			
25, 30, 30-286	\$299	\$359	\$419
35 & 40	\$229	\$289	\$339
50 thru 95 SCSI	\$429	\$469	\$549
PS/2	210MB	420MB	\$40MB
50 thru 95 IDE	\$429	\$599	\$729

CONTROLLER CARDS

ADAPTEC	Alone	w/Drive
A1522BASIC 16Bit SCSI	\$129	\$109
A1542CBASIC 16Bit SCSI	\$225	\$215
A2742 EISA SCSI	\$389	\$369
A2842 VESA SCSI	\$319	\$299
FUTURE DOMAIN		
1680SVP 16Bit SCSI	\$155	\$139
NexStor PCI SCSI	\$169	\$149
ALPHA RESEARCH CACHING CARDS		
S425I 16Bit IDE	\$99	\$89
S475I 32Bit Local Bus IDE	\$139	\$129
S485I 32Bit PCI IDE	\$229	\$219
S425S 16Bit SCSI	\$229	\$219
S475S 32Bit Local Bus SCSI	\$369	\$359

Many other types of controllers in stock.

CD ROM DRIVES

NEC	CDR900	4X	180ms	\$979
NEC	CDR510	3X	195ms	\$389
Toshiba	XM401	2X	200ms	\$319
Toshiba	XM4101	2X	320ms	\$219
Sony	CDU561	2X	295ms	\$289
Teac	CD50	2X	265ms	\$259
Pioneer External CD Changers (300ms)				
DRM602X	6 disc	307KB/sec		\$869
DRM604X	6 disc	612KB/sec		\$1149
DRM1804X	18 disc	612KB/sec		\$2059

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SCSI Drive, sound card (In retail pkg.)				
	MV	MS	SB	SA
MV=Media Vision Pro Audio 16. MS=Media Vision Pro Studio 16				
SB=Sound Blaster 16 SCSI. SA=Sound Blaster SCSI ASP.				
XM4101	\$359	\$389	\$419	\$459
CD50	\$399	\$429	\$449	\$489
CDU561	\$429	\$459	\$469	\$519
XM3401	\$459	\$489	\$519	\$559
CDR510	\$509	\$539	\$579	\$609
CDR900	\$1119	\$1149	\$1159	\$1199

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CD ROM Drive Towers - Multiple CD ROM drives in a single external enclosure. Great for networks, BBS, or business.

	2 Drive	4 Drive	7 Drive
XM4101	\$579	\$1259	\$2249
CD50	\$649	\$1389	\$2479
CDU561	\$699	\$1479	\$2639
XM3401	\$789	\$1659	\$2999
CDR510	\$939	\$1999	\$3499
CDR900	\$2119	\$4339	\$7489

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Caddies \$5 Macintosh CD Driver \$29
Altec Lansing ACS-100 Speakers \$109

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170MB \$269 / \$289 240MB \$329 / \$349
340MB \$379 / \$409 540MB \$619 / \$649

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IOMEGA 250MB QIC-80 tape drives include 3yr warranty, software, 1 tape. Alone w/drive
Internal fits 3.5 or 5.25 bay \$159 \$149
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SCSI Tape Drives

Kit is 16Bit card & 1 tape	Bare	Kit
750-15Gig Exabyte 2501	\$549	\$739
2Gig Conner 4320	\$799	\$969
2Gig HP 35470	\$929	\$1049
4-8Gig Conner 4324	\$1119	\$1329
4-8Gig HP 35480	\$1059	\$1279
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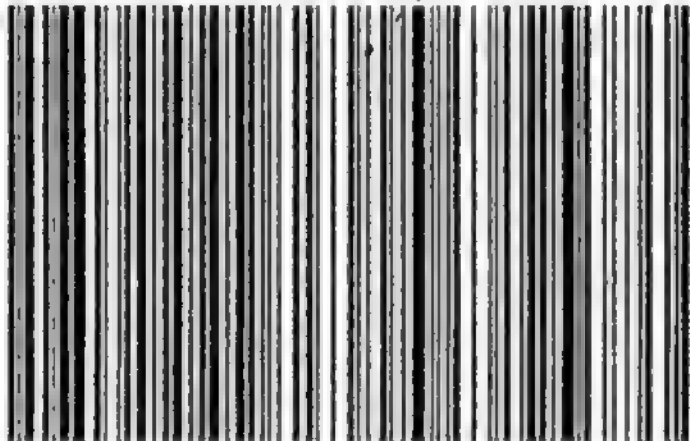
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1. Follow instructions on the other side

Back

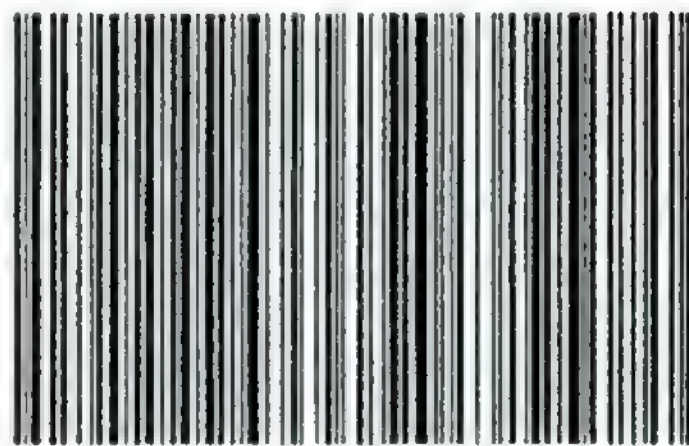
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Inverted Back

1. Follow instructions on the other side

Folded edge of the page



GbsSlipSheet-001

Inverted Foldout slip-sheet

Foldout slip-sheet

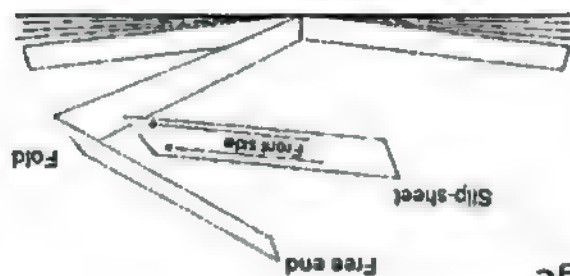
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2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

3. Slice the folded edge

4. Close the page and slip-sheet



1. Open the foldout page
2. Insert this sheet with
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3. Slice the folded edge
4. Close the page and slip-sheet



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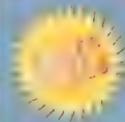
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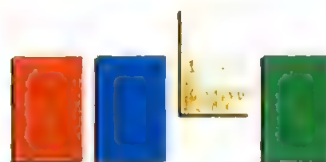
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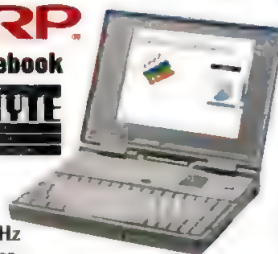
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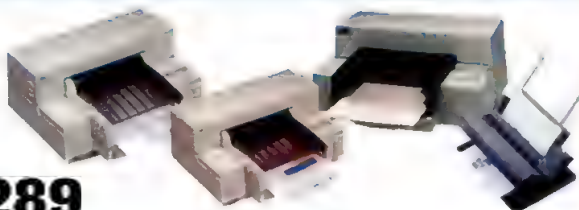
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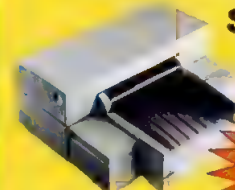
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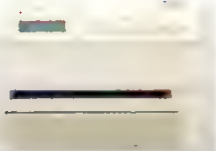


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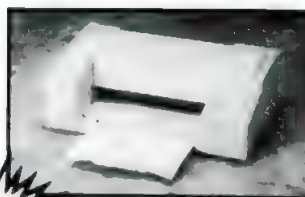
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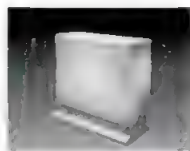
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ST13550M	456	1"	12	\$ 470
ST13655M	545	1"	11	\$ 490
ST137200M*	1050	1"	9	
ST11200M*	1050	3.5	11	
ST11900M*	1700	3.5	8	
ST11950M*	1700	3.5	8	
ST42100M*	1900	FH	13	
ST12550M*	2145	3.5	8	
ST12400M*	2100	3.5	9	
ST42400M*	2106	FH	10	
ST43400M*	2912	FH	10	
ST15150M-W*	4100	3.5	8	
ST1410800M-W*	9080	FH	11	
IDE				
ST1345A	130	1"	16	\$ 172
ST13243A	212	1"	16	\$ 196
ST13290A**	260	1"	16	\$ 218
ST13391A	341	1"	12	\$ 265
ST1350A	452	1"	12	\$ 334
ST13655A**	545	1"	12	\$ 413

TYPE	MB	SIZE	SEEK	PRICE
CF1A70S-A	170	1"	13	\$ 195
CF5210A	212	1"	12	\$ 198
CP30254H	250	1"	14	\$ 222
CF3A30S-A	340	1"	12	\$ 305
CF5A20A	420	1"	14	\$ 292
CFP1060S	1060	1"	9	\$ 759

TYPE	MB	SIZE	SEEK	PRICE
LP52705-A	270	1"	16	\$ 247
LP53405-A	340	1"	12	\$ 268
LP55405-A	540	1"	10	\$ 436
PD1225S	1225	3.5	10	\$ 884
PD1800S	1800	3.5	10	\$ 1000

TYPE	MB	SIZE	SEEK	PRICE
WD2250	245	F	14	\$ 221
WD2340	340	F	13	\$ 268
WD2420	420	F	13	\$ 286
WD2540	540	F	13	\$ 402

TYPE	MB	SIZE	SECK	PRICE
5C51				
DSP3107L	1050	1"	95	\$ 770
VP3107	1075	1"	8	\$ CALL
DSP3210	2100	3.5	9	\$ 1458
VP3215	2150	1"	8	\$ CALL
DSP5400	4000	PH	12	\$ 2452
SP3430	4300	3.5	9	\$ CALL

TYPE SCSI	MB	SIZE	SEEN	PRICE
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2217	1750	3.5	10	\$ 1030
1936	3050	FH	12	
4410	4100	3.5	8	
1991	9080	FH	11	
IDE				CALL!
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2217A	1750	3.5	10	700 GOOD
AUDIO VIDEO				TO PRINT
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2217AV	1750	3.5	10	

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1.7GB	3.5	HM	\$ 1030
2GB	3.5	HM	\$ 1430
3GB	5.25	FM	\$ 1950

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WANGDAT	3100	2-4 GB	4MM	\$ 870*
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WANGDAT	3400	8-16 GB	4MM	\$ 1070*
SONY	SDT2000	2 GB	4MM	\$ 780*
SONY	SDT4000	2-4 GB	4MM	\$ 840*
SONY	SDT5000	4-8 GB	2MM	\$ 988*
DEC	DLT 4060	20 GB	DLT	\$ 3175*

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256 x 1 (Video Zip)	3.50	3.00	2.75	2.50
64x4	3.25	3.25	3.25	3.25
64x1	2.00	2.00	2.00	2.00

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256 x 1 (Video Zip)	3.50	3.00	2.75	2.50
64x4	3.25	3.25	3.25	3.25
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Ambrax 386/486	4/8/16 Meg	CALL	CALL	CALL
Ambrax 386/486	4/8/16 Meg	CALL	CALL	CALL
Ambrax 386/486	4/8/16 Meg	CALL	CALL	CALL

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1 x 32 4Meg	190.00	180.00	178.00	178.00
2 x 32 4Meg	380.00	360.00	360.00	360.00
4 x 32 4Meg	720.00	690.00	690.00	690.00
256 x 32 1Meg	59.00	59.00	59.00	59.00
512 x 32 1Meg	80.00	80.00	80.00	80.00
1 x 32 4Meg	190.00	180.00	178.00	178.00
2 x 32 4Meg	380.00	360.00	360.00	360.00
4 x 32 4Meg	720.00	690.00	690.00	690.00
256 x 32 1Meg	59.00	59.00	59.00	59.00
512 x 32 1Meg	80.00	80.00	80.00	80.00

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83087-33MHz	78.00	80.00	85.00	85.00
83087-25MHz	78.00	80.00	85.00	85.00
83087-25MHz	78.00	80.00	85.00	85.00

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	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

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1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

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1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

MEMORY BOARDS				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

BOCA XT 8 BIT BUS				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

IBM P/S2 32BIT EXPANSION BD.				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

PS/2 MCA 0-8MEG EXPANSION BD.				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

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	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

IBM P/S1, P/S2 MEMORY MODULES				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

IBM NOTEBOOK & LAPTOP MEMORY				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

COMPAQ MEMORY MODULES				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

COMPAQ LAPTOPS & NOTEBOOKS				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

COMPAQ LAPTOPS & NOTEBOOKS				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

COMPAQ LAPTOPS & NOTEBOOKS				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

COMPAQ LAPTOPS & NOTEBOOKS				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

COMPAQ LAPTOPS & NOTEBOOKS				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

COMPAQ LAPTOPS & NOTEBOOKS				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

TOSHIBA LAPTOP MEMORY				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

NOTEBOOK, LAPTOP MEMORY				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

NOTEBOOK, LAPTOP MEMORY				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
16Meg x 9 (9 chip)	798.00	798.00	798.00	798.00

NOTEBOOK, LAPTOP MEMORY				
	486S	486S	486S	486S
1Meg x 9 (3 chip)	65.00	53.00	42.00	41.00
1Meg x 9 (9 chip)	60.00	59.00	49.00	48.00
4Meg x 9	165.00	165.00	165.00	165.00
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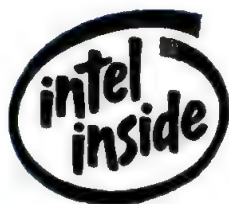
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Hitachi's high end digital 21 inch monitor offers industry leading features including an advanced flat, square 28 mm dp CRT for sharp focus, 31 screen presets. True color control plus white balance selection, MPR II low emissions, Energy Star, and pin cushion adjustment. 1600 x 1200 NI at a flicker free 70 Hz refresh rate. Optional keyboard computer control kit available. CM2188.....\$2,299

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- 24 Pin printer
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- Option Color Kit

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EPSP3260

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Epson LQ-2550 Color EPS2550C.....	879
Epson DFX-5000 EPSDFX-5.....	1,319
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* After \$25 rebate on Epson Stylus 800 through May 31st. This offer good on product purchased between Feb. 26 and May 31, 1994.



Epson Stylus 800

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The Paradise Accelerator Value Card is a super VGA video graphics card that accelerates the performance of Windows and windowing programs and provides resolutions up to 1280x1024 in 16 colors, or up to 65,536 colors for 800x600 resolution. Opening, closing, scrolling and resizing of windows is faster because the Paradise Accelerator Value Card features built-in acceleration.

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Nokia 447M 17" CM447B.....	1,199
Nokia 448S 14" CM448S.....	499

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SVGA color. CM5515G.....\$469
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MultiSync 5FGP 17", 28dp. NI, CMNEC5FGP.....	1,249



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17", 1280x1024, NI, 28mm dp. CM1760LR.....	749
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Silentwriter 1097 NCMDL1097.....	1,429

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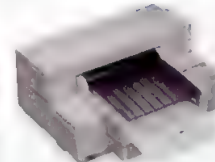
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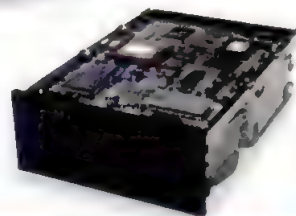
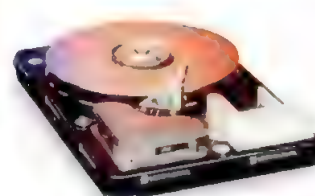
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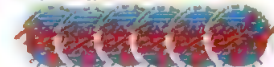
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11. REFERENCES

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PC MAG MAY 31, '94

How PC Direct Helped Computer Discount Warehouse Found "Customer University"

All the employees at the Computer Discount Warehouse are still in school. No, they're not teenagers anymore, but they're all enrolled in a program called CDW University — which they also call "Customer U."

"We believe that the only way to grow is to make the customer #1," says Michael Krasny, the company's CEO. "That's why we established an on-going, mandatory training program that focuses on customer service and product briefings. Our employees also have personal, hands-on experience of a lot of the products they sell — and they know how to treat the customer right."

The customer support program at CDW, a ten-year-old reseller of PC hardware and software, includes free technical support from 8 a.m. to 7:30 p.m. "We guarantee that support calls will be answered within three minutes," says Krasny. He also points out that a \$10 million product inventory makes it possible for the company to provide same-day order shipment.

Computer Discount Warehouse has turned their success into an opportunity to offer better customer service, and Krasny singles out his advertising in PC Magazine as the cornerstone of his success. "We've been in the PC Direct section since 1986, and we've never missed an issue. Our most loyal customers, the ones who appreciate service, come to us through PC Magazine. No matter how you look at it — closing rate, calls per ad dollar — PC Magazine is tops."

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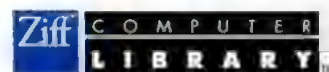
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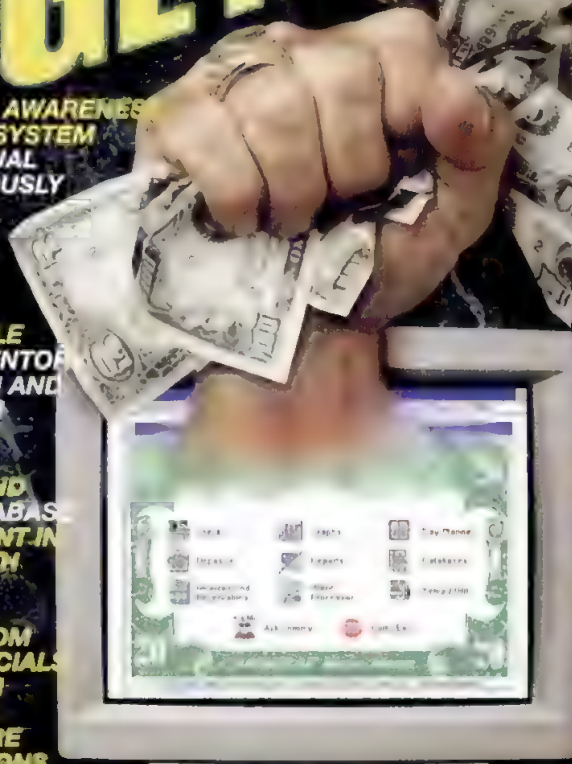
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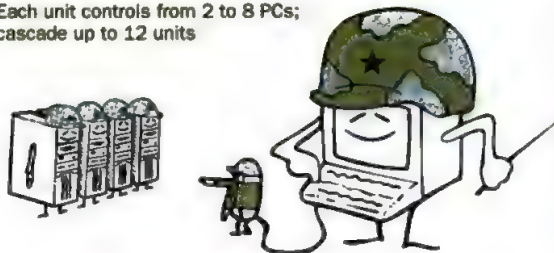
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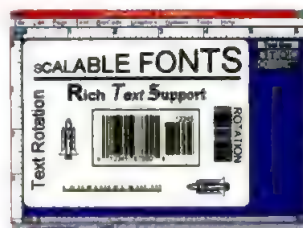
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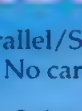
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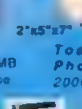
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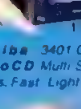
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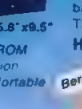
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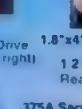
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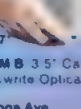
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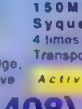
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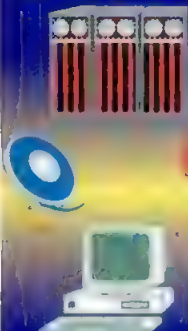
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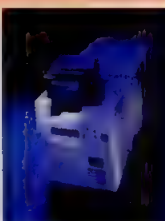
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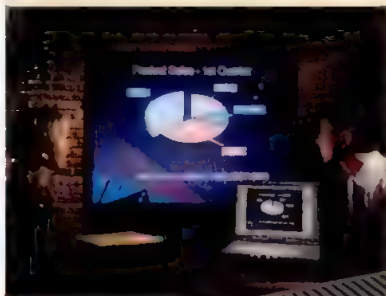
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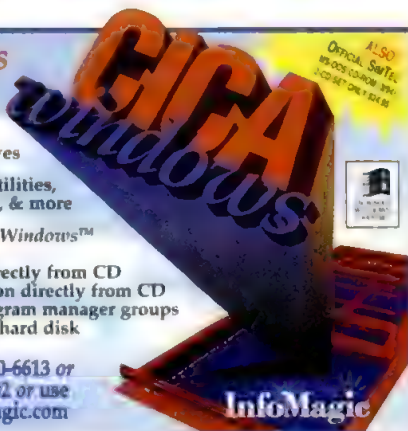
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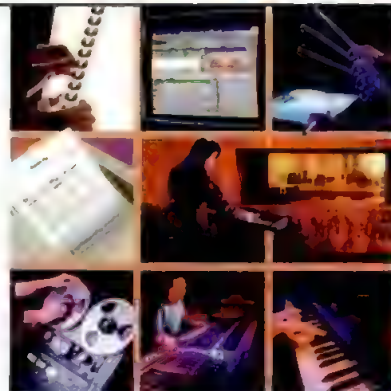
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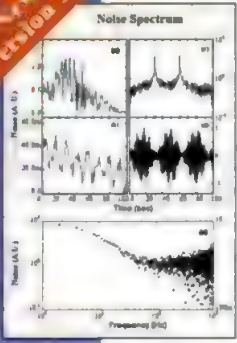
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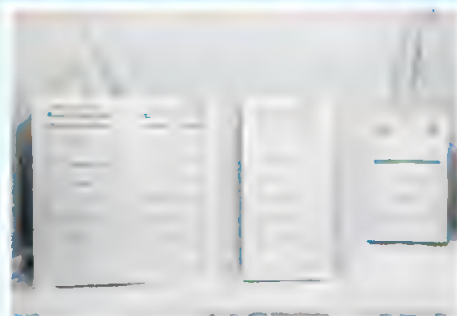
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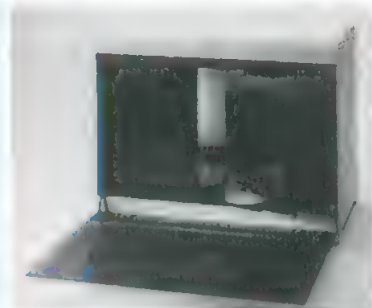
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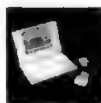
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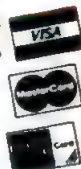


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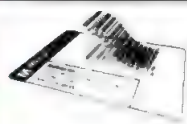
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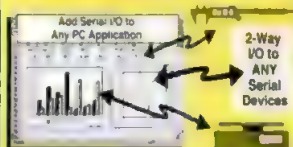
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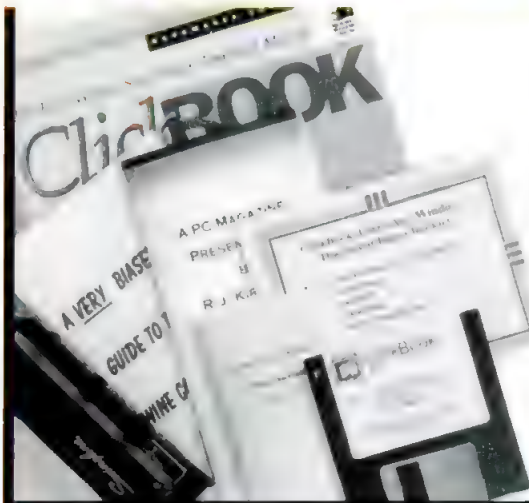
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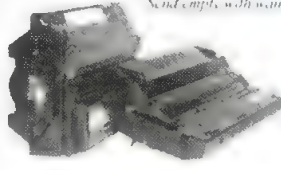
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Coming Up

The Changing Office

You've been hearing about the office of the future for a long time now. New technologies have changed the way people work, but the process is just getting started. We spend an entire issue examining the many packages that already deliver new ways of working—and we also preview what's in store down the road.

Changing Strategies Nowadays, when you choose an application—whether it's an e-mail or messaging system, database, document manager, word processor, or anything else—you're likely to buy into a vendor's complete strategy for document handling and delivery. We look at how several major vendors are proposing to deliver you into the changing office, in which all of your (their) applications work together.

Image Management and Group Discussions Keeping track of all your company's image and document files can be daunting, especially if several people need simultaneous access. Today, small-group image management software is changing the way we handle paper in the office. We also examine the latest offerings in discussion software—both for specific-decision and general-purpose conferencing—that can help facilitate a meeting of minds.

Workflow Automation Software In the context of exploring the changing office, *PC Magazine* scrutinizes the hot new field of workflow automation software: network-based tools for analyzing, redesigning, and supercharging business processes for more efficient, more profitable performance.

Videoconferencing Systems Will desktop videoconferencing be the killer app of the nineties? If so, are today's products ready? *PC Magazine* Labs tests seven PC-based videoconferencing systems over ISDN lines or our own Ethernet LAN to evaluate everything from video and audio quality to software features and usability. Find out how the technology needs to develop before videoconferencing comes to every desktop.

Whiteboard Software Whiteboard software begins where e-mail leaves off. We review four of the latest whiteboard packages that let workgroups view, edit, or just discuss documents and presentations in real time via LAN or modem.

Tutor

One of the hottest effects in computer graphics these days is morphing—animated sequences in which an object changes from one shape to another, or into a different object altogether. Our Tutor column shows you how software performs this seemingly magical transformation.

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After Hours

Travel: Automap Destination Ski, Automap Destination Europe, National Parks of America, Berlitz for Business: Japanese;
CD-ROM Pick Hit: In the Company of Whales; **Multimedia:** Touring Indian Country; **Adventure:** Sam & Max Hit the Road; **Spotlight on Action:** Gabriel Knight: Sins of the Fathers

TRAVEL SOFTWARE

Around the World and Still at Your Desk

BY DON TRIVETTE

It's not too late to plan a trip for the summer—especially if you can count on your PC for help. Whether your journey is within the United States, to Europe, or even to the Far East, there are some new packages that can make your trip easier to plan and more enjoyable to take.

Automap Road Atlas, a long-time favorite of the driving vacation set, now has two add-ons that expand the com-

puterized-road map concept. Both of the add-ons, Automap Destination Ski and Automap Destination Europe, rely on the core functionality of the parent product, which allows you to plan your driving route simply by selecting your starting and destination points; you can also choose whether you want to take the fastest route, the scenic route, or your favorite road. The program maps your route from one place to another and prints a detailed itinerary with distances, highway junctions, and driving times.

(For more on Automap Road Atlas, see the *PC Magazine* review of November 23, 1993.)

For all those who are interested in schussing down a snowy slope, **Automap Destination Ski** is a must. This add-



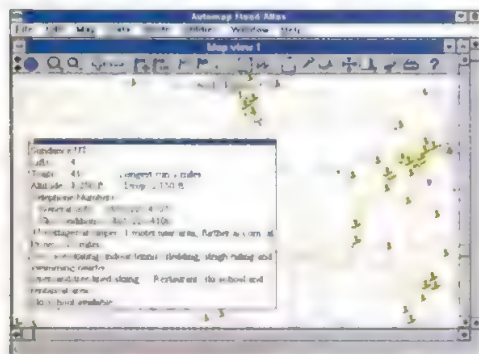
HIKE IT: National Parks of America lists 230 parks in the 50 states.

on provides a database of pop-up facts on 590 ski resorts in the U.S. and Canada; included is information about the size and altitude of the slopes, the number of lifts and trails, average snowfall, and telephone numbers for making your reservations. Although a few smaller resorts are missing, the data in this package is comprehensive; everything is here except the one thing you want most—the prices.

Automap Destination Europe is an add-on that tacks the highway systems of Europe onto Automap Road Atlas's compendium of United States roads. It uses the

same commands and pull-down menus of the original software, so you can plan a trip from Portugal to Poland as easily as you can from California to Kentucky. Missing, however, is information about exchange rates and customs regulations and helpful foreign phrases. To take maximum advantage of Destination Europe, load it onto a notebook computer and carry it with you.

More interested in seeing the USA first? What better place to start than in our national parks. **National Parks of America** is a multimedia index to 230 parks in the 50 states.



SLALOM: Find out everything you need to plan an alpine adventure with Automap Destination Ski.

FACT FILES

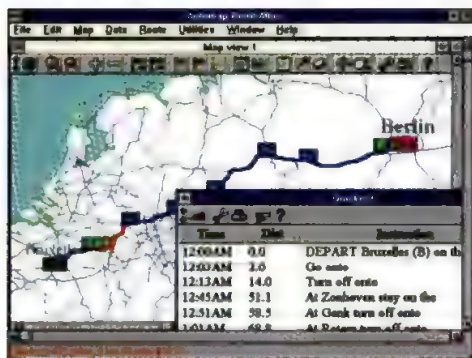
Automap Destination Ski, \$30. Requires: 300K of hard disk space, Automap Road Atlas, Version 3.0. Automap Inc., 1309 114th Avenue SE, #110, Bellevue, WA 98004; 800-564-6277; fax, 206-455-3667. Circle 445 on reader service card

Automap Destination Europe, \$50. Requires: 1.5MB hard disk space, Automap Road Atlas, Version 3.0. Automap Inc., 1309 114th Avenue SE, #110, Bellevue, WA 98004; 800-564-6277; fax, 206-455-3667. Circle 446 on reader service card

National Parks of America, \$60. Requires: 2MB RAM, Microsoft Windows 3.1, CD-ROM drive, SVGA display. Multicom Publishing Inc., 1100 Olive Way, #1250, Seattle, WA 98101; 800-850-7272. Circle 447 on reader service card

Berlitz for Business: Japanese, \$195. Requires: 4MB RAM, Microsoft Windows 3.1, CD-ROM drive, sound board. Bright Star, P.O. Box 600, Coarsegold, CA 93614; 800-743-7725; fax, 209-683-4468. Circle 448 on reader service card

After Hours



DRIVING: Plan your route from Brussels to Berlin with Autopam Destination Europe.

the number of camp sites, the fees, the length of trails, or the conditions of accommodations. Most savvy travelers will want to pick up a good paperback guide once they've selected a park.

For those with a Marco Polo bent, Berlitz

There's general information about camping, hiking, public facilities, and lodging, and the package includes addresses and telephone numbers as well. Each national park is covered in a short narrative with at least one color photograph; major parks have multiple photographs and a video clip. The photographs are by David Muench, whose work appears in *National Geographic* and *Sierra*. The photos were originally published in a coffee-table book of the same name.

National Parks does a good job of helping you select a park by region, state, or activity, but it lacks important details. There are no maps, for example, and while National Parks tells you that camping is permitted, it gives no indication of

for Business: Japanese is a great way to learn the language and customs of Japan. The Berlitz method of instruction does not emphasize grammar, spelling, or vocabulary lists, but rather relies on total language immersion. You watch and listen to real-life situations—for example, a man asking directions to a hotel—until the words and ideas are seared into your mind. Berlitz has been successfully teaching foreign languages this way for decades.

Berlitz Japanese is divided into twelve parts, with Language Essentials and Basic Expressions being the introductory lessons to the three kinds of Japanese characters: *kanji*, *katakana*, and *hiragana*. Once the basics are familiar, you can proceed to sections covering



SENSEI: Learn from a master with Berlitz for Business.

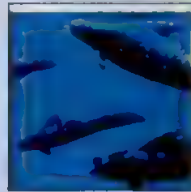
In the Company of Whales

Take an interactive journey to the depths of the seas with this beautiful disk from The Discovery Channel. The centerpiece of this in-depth look at whales and their environment is a 14-minute video overview, narrated by

**CD
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Patrick Stewart, which lets you explore the world of these giant creatures as they swim, feed, and sing.

With over 45 minutes of video—which includes an Ask the Experts segment—a wide array of still images, a hypertext glossary, and a robust search engine, this CD documentary is both informative and entertaining. *Traveling In the Company of Whales is an experience you won't want to miss.*—Gayle C. Ehrenman
In the Company of Whales, \$49.95. The Discovery Channel, 301-986-0444, ext. 5880.



In the Company of Whales

At a Glance

Whales in Motion

The World of Whales

Ask the Experts

arrival, hotels, business, telephone customs, dining out, travel, shopping, and entertainment. There's none of the pen-of-my-aunt vocabulary so often found in language courses; the situations are real ones that a traveler—especially a business traveler—might encounter.

Using a microphone (not included), you can record and play back your own dialog to evaluate your progress and sharpen your pronunciation. If you are a diligent student who is actually journeying to Japan, you can easily learn enough of the language to show your hosts that you have made an effort. The sections

on customs, geography, and history are especially interesting and are a good source of background for the casual student.

The organization of topics and lessons is clear and logical. It's easy to skip forward or to repeat a difficult lesson, and you never feel lost among complicated menus. The Japanese-English dictionary is something of a disappointment, however. When you click on a foreign word in a multimedia dictionary, you expect to hear it pronounced. Unfortunately, though, this dictionary is mute. Important phrases would also be a helpful addition.

MULTIMEDIA

Touring Indian Country

BY GAYLE C. EHRENMAN

No trip across America would be complete without a little cultural enrichment. Part travel guide, part historical reference, Touring Indian Country provides textual and visual information on more than 300 contemporary Native American tribes across the United States.

As a cultural guide, it details the history and rituals of the tribes, as well as their art

forms and ceremonies. There's even an Indian Moons guide that explains what each of the tribes calls the months of the year. For example, the Cheyenne call May "Moon

when the horses get fat," while the Creek simply call it "Mulberry moon."

As a travel guide, Indian Country provides addresses and phone numbers for the tribal offices or reservations and visitor contact information. There's also a calendar of events that lists a variety of Native American activities throughout North America, ranging from powwows to Indian markets, cultural conferences, and rodeos.

It's easy to find exactly what you're looking for here, thanks to a simple-to-navigate geographical interface. To find tribal information, you just click on the region you're inter-

ested in on a U.S. map, then choose a state and ultimately a tribe. While you're reading the text, you'll be serenaded by an engaging soundtrack of modern and ancient American Indian music, which includes a selection from the first Native American rapper, Litefoot.

For those interested in exploring the heritage and culture of Native Americans, either as a physical or educational journey, Touring Indian Country is an indispensable resource.



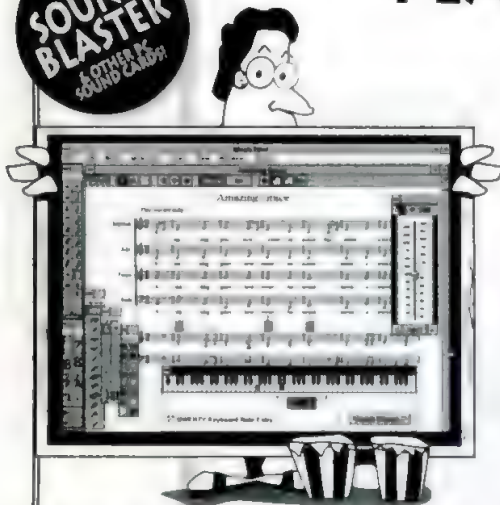
TOURING INDIAN COUNTRY: Learn the ways of the Chippewa.

Touring Indian Country, \$39.98. Requires: 8MB RAM, 8MB hard disk space, Microsoft Windows 3.1, 256-color display, double-speed CD-ROM drive, sound card. MPI Multimedia, 5525 West 159 St., Oak Forest, IL 60452; 708-535-1540.

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ADVENTURE

Take a Road Trip to Remember

BY BARRY BRENESAL

Combine Raymond Chandler's tough, seedy detectives with the manic animation of Tex Avery's 1940s cartoons. Throw in deadpan verbal humor that references everything from Milton to fast-food corn dogs and set this monster rolling against middle-class tourist traps. The result is *Sam & Max Hit the Road*.

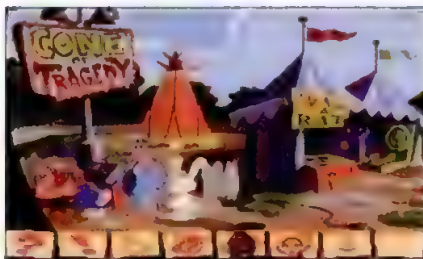
In this graphics adventure you play Sam, a laconic canine gumshoe. You're accompanied by your pal Max, a hyperactive rabbit who lives for vio-

lence. Together you investigate the mysterious disappearances of Bruno the Bigfoot and Trixie the Giraffe-Necked Lady from the Kushman Brothers' Circus. You will meet many interesting people, such as Conway Bumpus, author of the country hit, "Let's Get Drunk and Shoot Things." And you'll travel to exotic places such as a yeti convention and the Celebrity Vegetable Museum.

Hit the Road is the funniest graphics

adventure since LucasArt's *The Secret of Monkey Island*. The plot and visuals draw you into a bizarre world that is refreshingly vulgar and wittily erudite at the same time.

A few recent graphics adventures have incorporated brainteasers to vary and increase the challenge. Genuine brainteasers would be out of place in a game like *Hit the Road*, so its creators have pro-



WHEEE! Try rides like the Cone of Tragedy in *Sam & Max Hit the Road*.

vided their own substitutes. In *Hiway Surfin'*, for instance, you gain points as Max successfully jumps over highway signs from the top of the team's speeding car. You might also try *Car Bomb* or *Wak-A-Rat*.

The puzzles aren't easy to solve, but then this isn't the kind of game you play for any sense of vicarious achievement. It should be relished slowly, allowing its gleefully deranged humor to blossom in its own time.

Sam & Max Hit the Road, \$59.95. Requires: 580K RAM, 16MB hard disk space, DOS 3.1 or higher. LucasArts Entertainment Co., P.O. Box 10307, San Rafael, CA 94912; 209-683-4468.

Circle 450 on reader service card

Journey to the Dark Side with Gabriel Knight

By Barry Brenesal

If you enjoy quality radio drama and music, you'll love *Gabriel Knight: Sins of the Fathers*. It's not quite the CD-ROM blockbuster title we've all been hoping for, but it points to the future of this media.

Gabriel Knight is the story of an investigative author who begins to experience terrible nightmares soon after he starts researching voodoo in New Orleans. These nightmares lead to revelations about a centuries-old curse.

Whether Knight destroys the curse or becomes its victim is entirely up to you.

What's most striking about this graphics adventure isn't its visuals—a mix of well-designed CGA scene shots and striking VGA portraits—but its use of sound. More than any other CD-based game, *Gabriel Knight* relies on an extensive musical score and narration for its drama. By default, the

game has characters speak their novel's worth of comments. There's also a vocal narrator who takes the place of the visual descriptions that normally pop up when you examine an object. You can always toggle the audio off and visual text on, but that means you'll miss the acting of an excellent cast, which includes Mark Hamill; Michael Dorn; Efrem Zimbalist, Jr.; and Tim Curry as Gabriel Knight.

The game itself isn't quite up to the audio, unfortunately. It's not that *Gabriel Knight* is bad. The writing is

flavorful and the dialog idiomatic, even if the plot's hinges creak throughout. The problem is that *Gabriel Knight* straddles two platforms. While the audio was designed for CD use, product development was clearly governed by concerns for distribution on diskette. This translates into a game of only average length, interest, and complexity, with no more than the usual number of objects and sites.

Like other graphics adventures, this is less an interactive novel than a series of puzzles. Completely linear, *Gabriel Knight* walks only one path to its conclusion.



GABRIEL KNIGHT: Visit castles and caverns as you unravel the ancient curse.

Gabriel Knight: Sins of the Fathers, on disk, \$59.95; on CD-ROM, \$69.95. Requires: 640K RAM, 4MB EMS, 4MB hard disk space, DOS 5.0 or later, VGA display, mouse. Sierra On-Line, Coarsegold, CA 93614-0800; 800 326-6654.

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Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

Hickory dickory
dock. Take a good
look at the clock.
(Borland ad.)

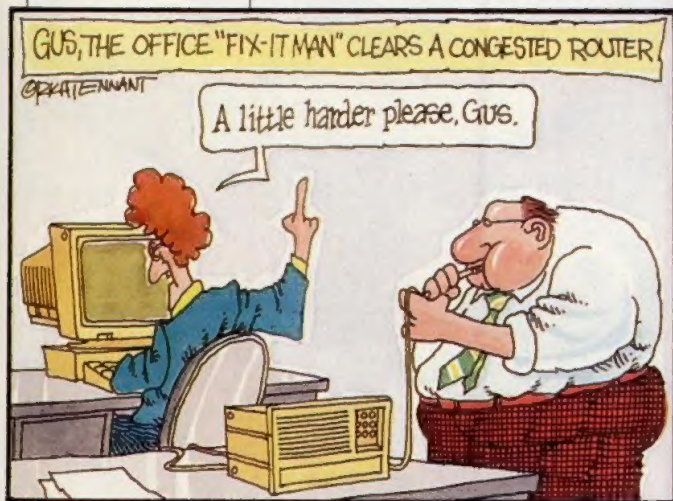


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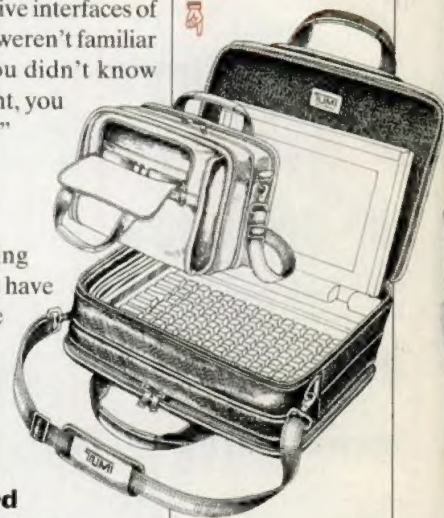
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